

JANUARY 1963

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Popular Science

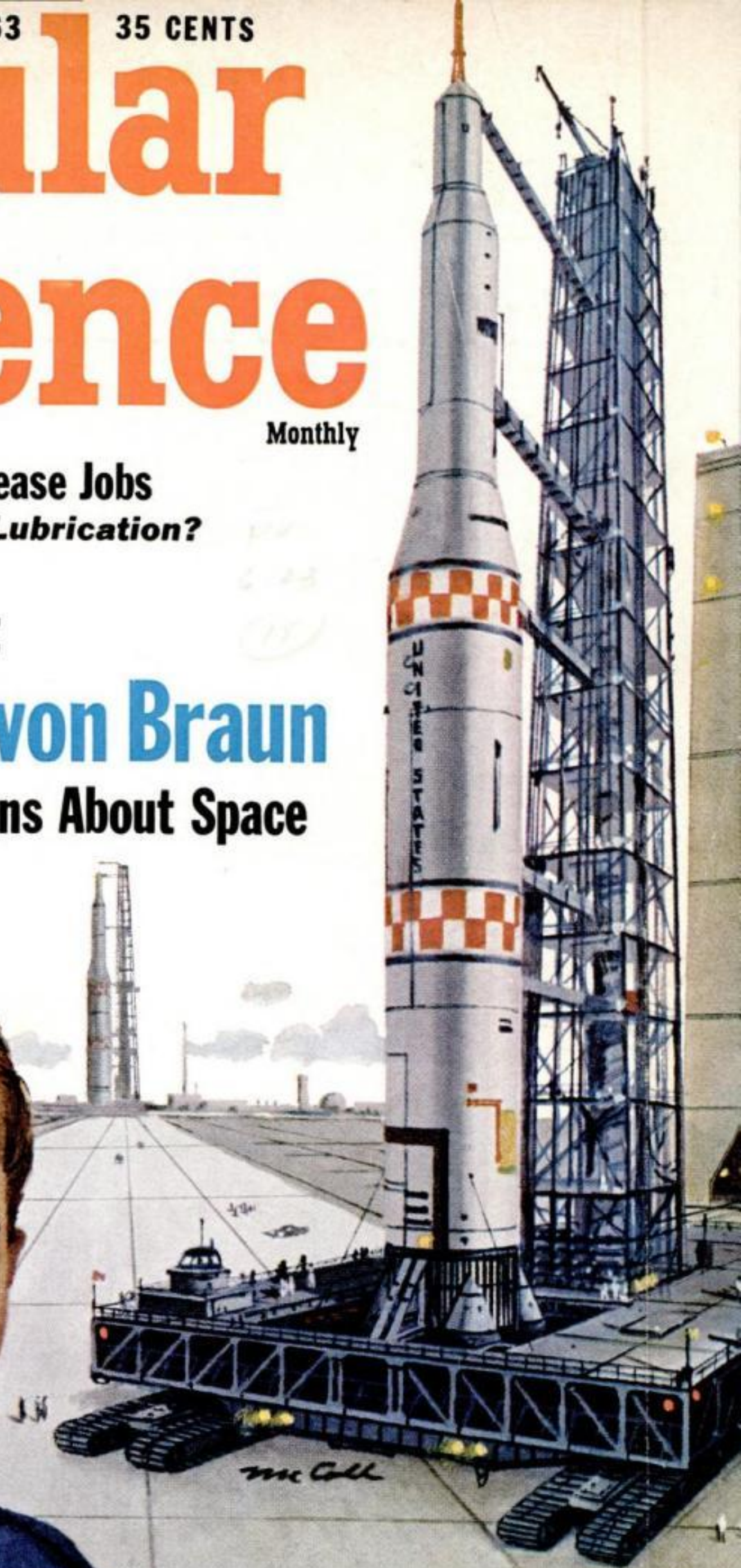
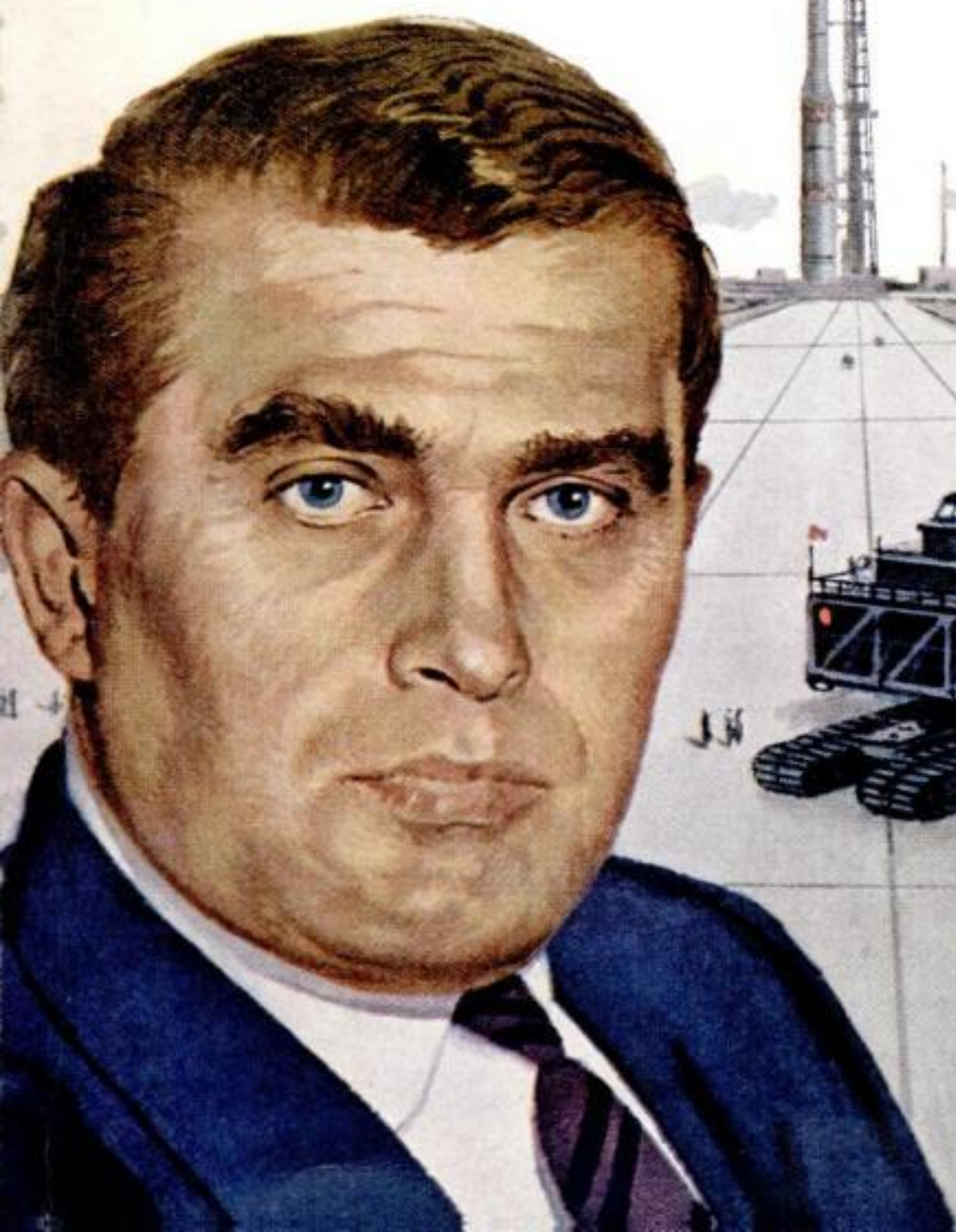
Monthly

30,000 Miles Between Grease Jobs
—How Safe Is Extended Lubrication?

Starting This Month:

Dr. Wernher von Braun

Answers Your Questions About Space



Coast-to-Coast Driving Report
on Dodge's New Motor Home

NEWS OF A REMARKABLE HEALTH INSURANCE PLAN

For the 7 out of 8 who need more protection

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Can you tell which Tempest is the tiger?

Easy. The Le Mans on the right gets its power from our 4—that's the big 4 that stalks around acting like a V-8. So you have to call it a tiger.

The other Le Mans Sports Coupe has our new 326-cu. in. V-8 tucked away under the hood—all 260 bhp of it. That's good for two tigers. At least. We call it the V-326. It's for people who are willing to admit that our 4 does go around acting like twice life size but still hanker for an heroic V-8. So what's actually with this Two-Tiger V-8 that rates it more than a passing blurb? A weight-to-power ratio of under 12*

to 1 that bows only to machines so muscle-bound they can't be driven happily on the street. A whole bunch of nonsense torque—352 lb/ft of it. And the only thing smoother drinks kerosene and carries stewardesses.

Suggestion: Take a Le Mans with a Two-Tiger (we've got to stop calling it that or nobody'll remember its real name), order it with \$6.24† worth of heavy-duty suspension and one of our no-extra-cost performance axle ratios. Then sit back in that left-hand bucket seat, depress the loud pedal, and blissfully contemplate The Good Life.

*Optional at extra cost. †Manufacturer's suggested retail price for specified optional equipment (incl. reimbursement for Federal excise tax). State and local taxes extra.

Wide-Track Pontiac Tempest

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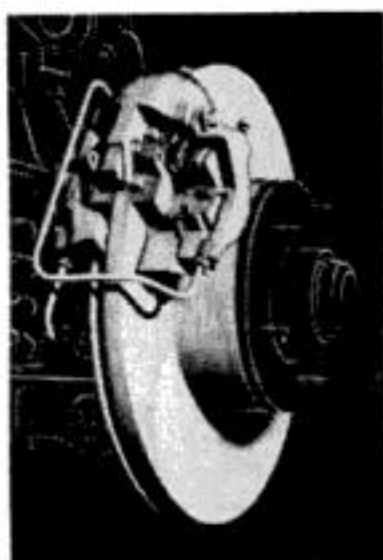
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January
1963

Cover painting
by Bob McCall

If disk
brakes are
so good, why
don't more
U.S. cars
have them?
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on page 76.



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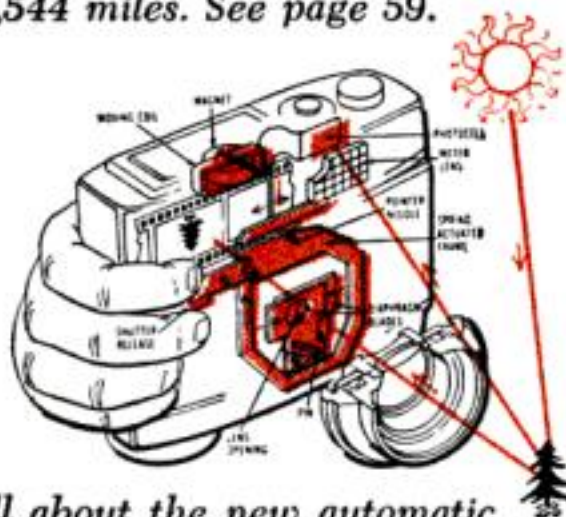
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This Motor Home was where
Devon Francis hung his hat
for 4,544 miles. See page 59.



All about the new automatic
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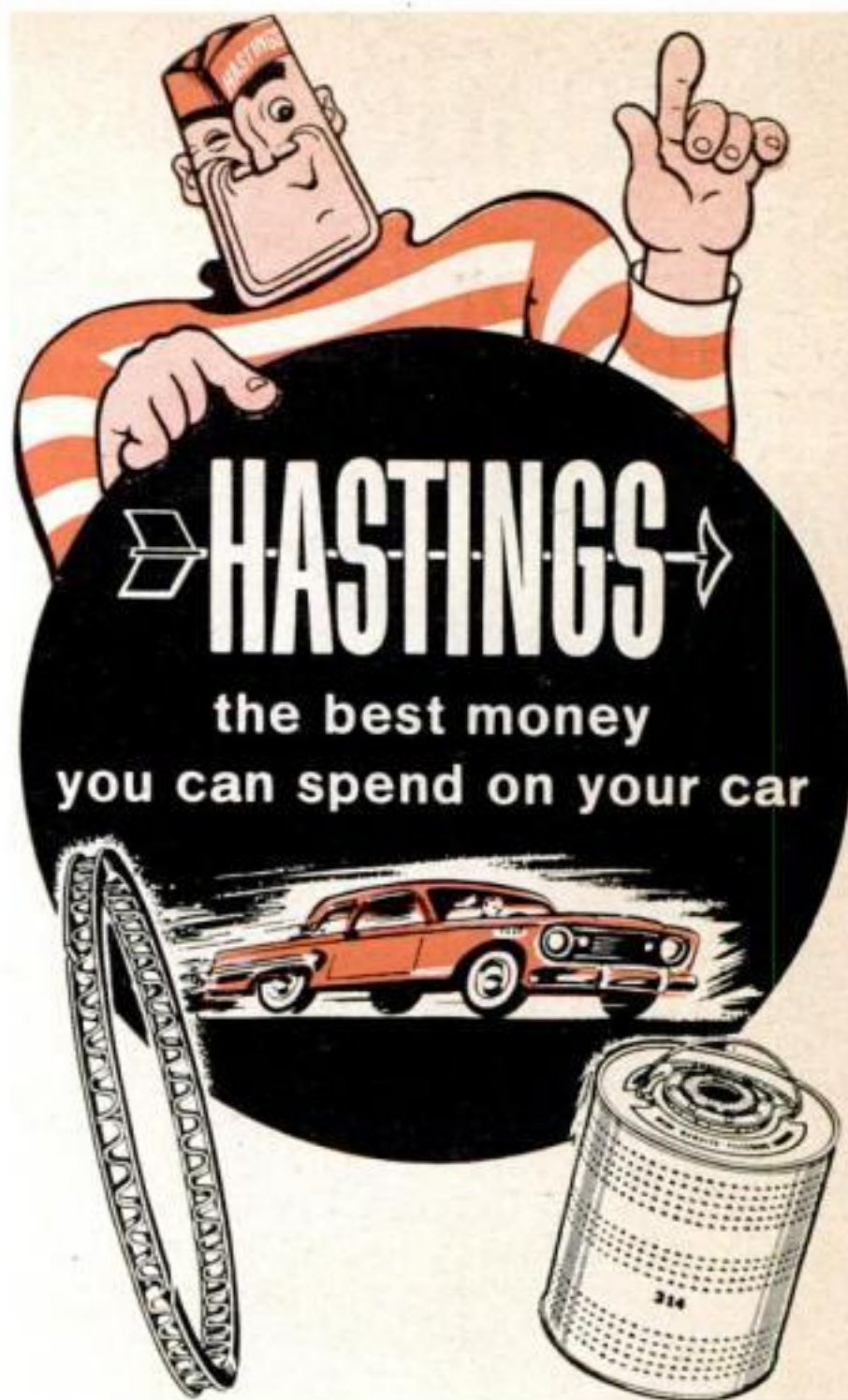
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HASTINGS PISTON RINGS

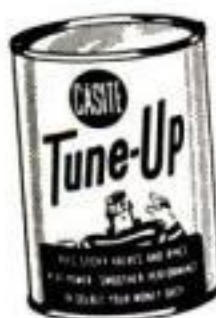
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Ask Your Service Man for Hastings Products

**HASTINGS MANUFACTURING COMPANY
HASTINGS, MICHIGAN**

PS readers talk back



That Japanese Scorcher

Thanks for the article on the CB-77 ["Hot Little Honda," Oct.]. Here in Japan, motorcycles outnumber cars because of their comparative cheapness and the country's small roads.

Honda puts out a variety of motorcycles ranging from 50cc. to 305cc. in displacement and from around 40,000 yen (just over \$110) to 190,000 yen (about \$525) in price. However, although by far the largest producer of motorcycles in Japan, Honda is in tough competition with several other makers.

Incidentally, you refer to the CB as "small." How about Honda's 50cc. Sports Cub, Super Cub, and Port Cub; Yamaguchi's 50cc. Autopet, and Suzuki's 50cc. cycle? These are small machines, but very popular here—in fact, the roads are clogged with them.

JOHN KIRCHER, Yokohama, Japan.

A Boatman Buys a Prop

"The Right Prop for Your Boat" [Oct.] was interesting, but you hardly mentioned the adjustable prop. I bought one against the advice of many experienced boaters. I am well satis-

fied; I think it is the only answer to the right pitch for all load conditions. I can't see why they are not more popular. Nearly all airplanes have used them for many years. Their props, of course, are automatic, a feature not necessary for boats, where adjustments can easily be made by hand without tools.

SHERMAN ROBERTS, La Crosse, Wis.

A Question for Buick

Just read the letter from Mr. G. H. Rideout of the Buick Motor Division [Oct.]. I am wondering where he got the idea that Buick started the current bucket-seat trend in 1960. The T-Bird had bucket seats in 1958. What model of Buick had bucket seats—even in 1960?

LAURIE HAWN, Winnipeg, Man., Canada.

Good Idea Turns Sour?

Putting postage meters on mailboxes [I'd Like to See Them Make," Oct.] may sound like a good idea but, as a mailman, I can see how long they would last. Mailboxes on street corners are damaged, pulled up from foundations, stripped of time cards, crammed with



trash (paper, cigars, cigarettes). Now somebody wants stamp machines put on them so he won't forget to mail a letter.

ALBERT VASILIAUSKIS, Chicago.

Machine Shop Joins the Air Force

Your article, "Hitch a Hand Grinder to a Lathe" [Nov.], prompts me to write you of a friend of mine, Joe Brown, an AF sergeant out in the boondocks faced with a problem: how to properly work on his motorcycle.

He bought an old Oldsmobile, stuffed three truck batteries under the hood, and rewired the car for 12 volts. Then he hooked up an

CONTINUED

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EDITORIAL OFFICES: 355 Lexington Ave., New York 17, N. Y.

PUBLISHED MONTHLY by Popular Science Publishing Co., Inc., 355 Lexington Ave., New York 17, N. Y.

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in the
shuffle?**

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- ☐ Sales Training

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- ☐ Auto Body Fender
- ☐ Refrigeration
- ☐ Air-Conditioning
- ☐ Diesel
- ☐ Drafting
- ☐ Welding
- ☐ Motor Tune-up

HIGH SCHOOL

- ☐ High School Diploma
- ☐ Commercial Course
- ☐ College Preparatory
- ☐ Secretarial Course

CAREERS FOR WOMEN

- ☐ Machine Shorthand (Stenotype)
- ☐ Dental Assistant
- ☐ Secretarial
- ☐ Accounting
- ☐ Bookkeeping

Name.....Age.....

Address.....County.....

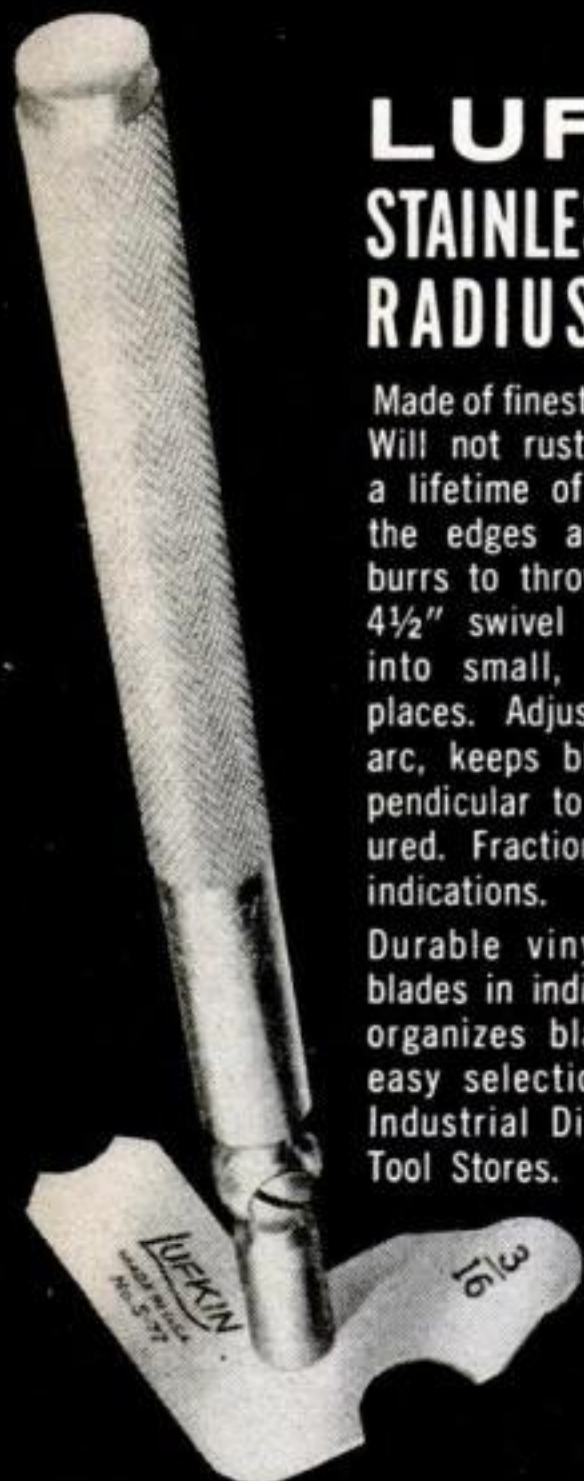
City & Zone.....State.....

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CHECK ALL



- 1 INSIDE CORNER
- 2 OUTSIDE CORNER
- 3 INSIDE ROUND
- 4 OUTSIDE ROUND
- 5 CONVEX SURFACE



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SAGINAW, MICHIGAN

oversize generator and some heavy cables and—presto!—an arc welder. The DC welder is powerful enough to be used as an arc cutter, and the batteries can be recharged in a day.

After stowing all his tools and parts in the trunk, he ripped out the rear seat. There he mounted a 6" lathe, driven off the car batteries. A ½" drill motor was clamped to the tool post and he had a tool-post grinder! To cap it all, an old brake drum was cut and welded with the arc torch to take a vacuum-cleaner motor. He filled the drum with charcoal and—lo!—a small forge.

With an expenditure of about \$200, Joe has a rolling machine shop, storage trailer, and, incidentally, transportation. The rig works, too. Joe borrowed a set of expensive, factory racing cams and traced the contours. Then he Stel-lited his own stock cams with the welder and ground them to shape on the lathe. Not bad, eh?

V. M. GREENE, San Francisco.

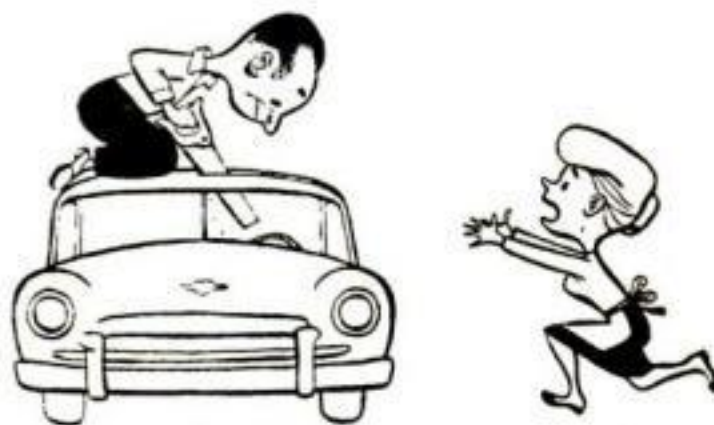
Caught with Our Cams Down?

In your Detroit Report [Nov.] you mention that the new Willys Wagoneer is the "first U.S. car with a six-cylinder OHC engine." How about the Stutz Black Hawk or the Duesenberg?

DENNIS WAGNER, Cornwells Hts, Pa.

How Many Gears in Half a Chevy?

I have a cut-down '50 Chevy. I cut the car in half, keeping the transmission end with its



three forward gears, one reverse. I then put in a truck transmission and added the truck rear. The truck transmission has four forward gears; one for backing. Of course, when both transmissions are in reverse, the car goes forward. The question is, how many gears (forward and backing) do I have? I count 32.

S. N. BAKER, Middlebourne, W.Va.

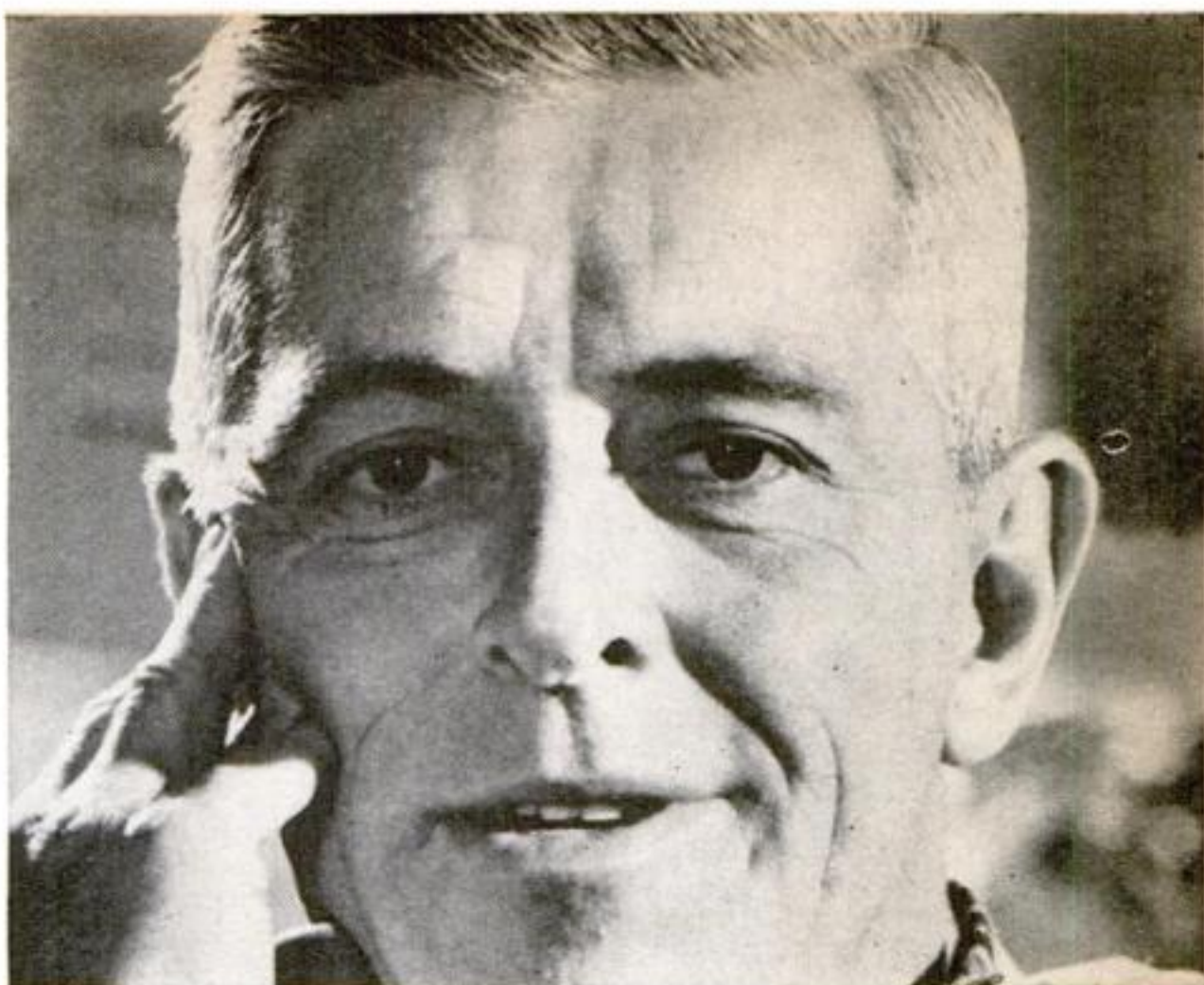
We count 13 speeds forward and 7 speeds in reverse.

Getting Hep on Scatter

In "The Other Fellow's Job" [Oct.] you say that George C. Schmitt, Texas Tower man, operates tropospheric-scatter radio equipment that bounces radio waves off the ionosphere. This is incorrect. Tropo-scatter systems bounce radio waves off the troposphere—the lower at-

CONTINUED

“How I retired in 15 years with \$300 a month”



“**K**NOW WHAT makes the difference between worrying all the time or actually enjoying yourself? Security, that’s what. I’m happy to say my wife and I figured that out in time. Now we’re retired without a care in the world. We’re getting a check for \$300 a month . . . guaranteed for as long as we live!

“All my business life I was self-employed. Had my own shop, and it treated me well through the years. But I spent practically every waking moment in it.

“Business was good, but I guess when a man hits 40 he starts to worry more about the future. Well, I was no exception. I began to wonder how I’d have the strength to work 12 to 14 hours a day when I hit 55 or 60. Besides, there were so many things Jennie and I had always wanted to do, but just never got around to. Usually we were too busy to even take vacations.

“The day we celebrated our 15th wedding anniversary, Jennie said, half jokingly, that she thought it would be a wonderful idea, as a gift to ourselves, to start a plan for our future. She showed me the advertisement she had clipped on the

Phoenix Mutual Retirement Income Plan. It said that a man of 40, with 15 or 20 earning years ahead, could retire with a guaranteed income of \$300 a month or more. It sounded good to me.

“We sent that coupon in, and it wasn’t very long before we started our Phoenix Mutual Plan. We’ve never regretted it.

“Well, I retired last year. Our first check from Phoenix Mutual arrived, and Jennie and I got busy. We sold the shop and found just the house we wanted in Florida. It’s been like paradise for both of us. And the greatest feeling is the security we have—knowing we have a *guaranteed* income coming in every month for the rest of our lives.”

Send for free booklet

This story is typical. If you begin early enough, you, too, can plan to have an income of from \$50 to \$300 a month or more—starting at age 55, 60, 65 or older. For more details, send the coupon and receive, by mail and without charge, a booklet which tells about Phoenix Mutual Plans. Similar plans are available for women and for Employee Pension Programs. Send for your free copy today!

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☐ Check box and **SAVE 45c** delivery charge by enclosing **WITH** coupon in envelope entire payment of \$9.95 for Auto Repair Manual (or \$11 for Truck Repair Manual) plus sales tax. Same 10-day return-for-refund privilege.

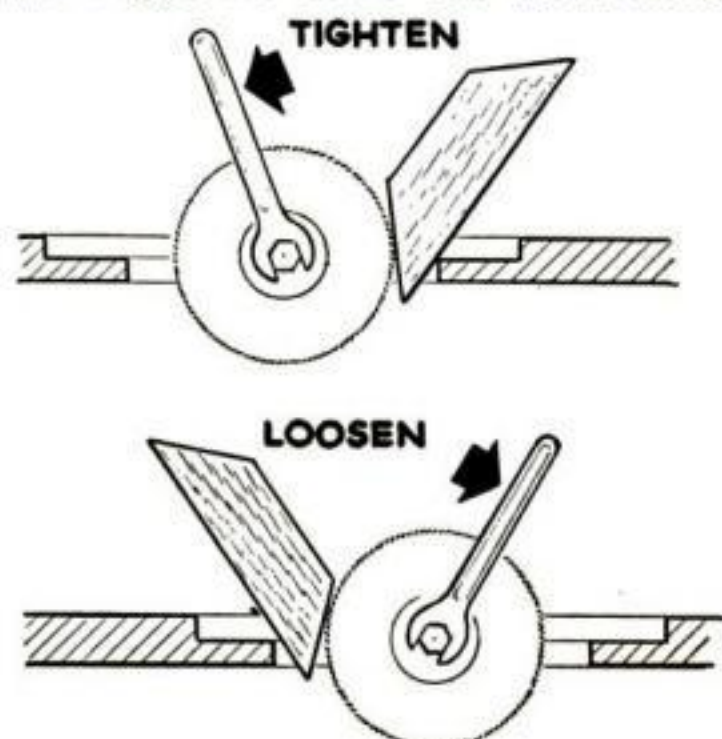
mospheric layer. The system that uses the ionosphere is called, appropriately, ionospheric-scatter.

I am employed as a radician (electronics technician) on the DEW Line. My duties are the operation and maintainance of the radar and tropospheric-scatter equipment.

MICHAEL SHAW, APO, NYC.

Case of the Table-Saw Wedge

I have been studying the tip on using a wedge to get the arbor nut off a table saw



["No More Cut Fingers," Oct., p. 143]. It appears that the arrows should be pointed in reverse; or the wedges should be located on the other side.

JOHN L. POLK, Loudonville, N.Y.

The drawing is correct. The saw shown happens to have a right-hand spindle with left-hand thread, so you turn the wrench counter-clockwise to tighten, clockwise to loosen. But the position of the wedge block would be the same for any saw. You turn the wrench away from the block instead of toward it to keep the wood from jamming down into the table slot where it would be hard to remove. You get plenty of leverage against the blade with the block as shown.

The '63 Detroit Crop

How come Ford claims the first three-speed manual transmission in U.S. automotive history to be synchronized in all three gears ["The Ford Stable, Oct."]? The Packard Motor Company had a transmission of this description from 1936 right until the company was discontinued in 1954.

GARY GERNERT, Chatham, N.J.

. . . That Galaxie acceleration—400 hp. pulling about 4,000 pounds from 0-100 in 17.4 seconds—I would call progressing backwards. Back in 1929 I owned a production in-line eight of 265 hp. weighing over 5,800 pounds. It could consistently do 0-100 in 17 seconds

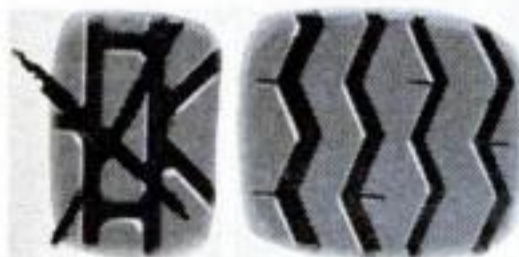
yes, outwears! yes, any other!

The new Goodyear Super Hi-Miler outwears any other truck tire of its kind! Here's why:



1. New, wide tread.

Reduces the rate of wear because tread wear is distributed over a much wider area.



2. All ribs continuous.

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3. New shoulder design.

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on dirt or gravel roads with a three-speed nonsynchro box. It could hit 90 m.p.h. in second gear and over 130 in high.

The Duesenberg SJ had steering of about three turns lock-to-lock without power steering and it was as easy to drive and park as a modern compact with slushbox. Even on a Caddie, 3½ turns is more than enough, without power steering, if the driver will let the car roll while turning the wheel. But, too many stand on the brakes and then try to overcome them as well as the dead weight of the car.

NEIL MANNERUD, New Brighton, Minn.

... Congratulations on the best issue ever printed. Your new-car section was informative and complete. One correction. The Le Mans convertible [Detroit Tests the '63 Cars, Oct.] is not a first. Tempest had one in '62.

ALAN SILVER, Brooklyn, N.Y.

Correct.

Filtering Out an Odor

Lines from "Gus Puts the Squeeze on a Penny Pincher," [Oct.]: "He opened the fuel filter and drew out the cartridge. It was surprisingly clean—and also smelled of gas."

What did he expect it to smell like—"My Sin"?

BILL HELLINGS,
Newport Beach, Calif.



Oops! Should have read oil filter, of course.

Anybody Know This Antique?

I own a rather curious and ancient gasoline engine patented in 1910 and made by the Seiverkropp Engine Co., Racine, Wis. A stationary engine, it is about 18-20 inches high and has two pistons moving up and down, both connected to the same wrist pin, with the connecting rod between them. It has two rather husky flywheels and is water cooled. The two-inch pistons have a two-inch stroke, and a glass drip-type oil cup on each side oils them.

The engine has no valves—just ports—so I suppose it would be a two-cycle. The gas tank is at bottom with the crankcase just above. There seems to be a plug to drain the crankcase, but not to fill it. I don't know if you have to put oil in this or if the oil cups drain enough oil down around the pistons to oil these bearings. I assume it isn't necessary to put oil in the gas since each piston has an oil cup.

It would be interesting to know how many of these engines were made and any history old-timers can supply.

C. R. BUNDY, Madera, Calif.

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The march of SCIENCE

By Martin Mann

Moose: the space life raft for astronauts

The worst nightmare of the space program is the obvious one: Suppose a manned capsule conks out after it is in orbit? The astronaut would be stuck—forever. The vision of a brave man slowly freezing or starving to death while the whole world listens gives even tough-minded planners the willies. Only now is work beginning on ways to escape from a broken-down spaceship.

Three schemes have been suggested:

1. A rescue party could rocket up to take the astronaut off his wreck. This involves a rendezvous in space—tricky enough between two operating craft and much worse if one were a derelict.

2. The capsule could carry a lifeboat: a small, extra craft like the bug that is to land on the moon. The astronaut would simply abandon ship and zip earthward in his lifeboat. The drawback to this idea is weight.

3. There could be a life raft: a sort of poor man's rough-and-ready spaceship.

The space-raft idea is now being explored by General Electric, which has built some parts of a system called Moose (stands for "man out of space easiest," they claim). Resembling the rafts carried in transoceanic airliners, it would take up little room, and weigh 322 pounds. It is intended for emergency return from satellites of the earth

no more than 450 miles out. Here's how it would work:

The astronaut, wearing his regular space suit and an emergency oxygen supply, zips himself up inside a big, double-walled plastic sack. Then he pushes himself out of the disabled capsule into space. He can't fall—he is weightless, in orbit with the capsule, and will continue to travel with the capsule.

He waits until he reaches the return point of his orbit (this would have been calculated in advance). Then, aiming himself with a special scope, he fires a retrorocket that is attached to the plastic sack. This kicks him out of orbit towards earth, back first.



Man in the box is being embedded in plastic foam to test part of a system that would enable astronauts to escape should a space capsule become disabled while in orbit.

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The March of Science . . . continued

Next he opens a folding shield made of a new material that will absorb the tremendous heat generated by friction with the earth's atmosphere. The material carries the heat away by turning to vapor. As the heat shield unfolds, the sack fills with foaming plastic (similar to the stuff used to make boats buoyant). The astronaut will be almost entirely embedded in the solidified foam, which will cushion the shocks of slowing down.

When this strange space raft gets down to 30,000 feet, its parachute will open, and beacons and flares will alert rescuers to its position.

Commented one engineer: "You might say the ride down in Moose would be exciting, but it would be a lot better than staying there."

Poisons in food—but natural ones

The hullabaloo over harmful chemicals in food has taken a reverse twist. Some doctors now suspect that defi-

- Hydrogen engine: Moon vehicles may be powered by turbine-generators driven by compressed hydrogen gas, the Martin Co. suggests. The exhaust would be collected aboard the vehicle and recompressed at a service station. . . . No elite disease: Foremen get ulcers more often than executives, reports Dr. James P. Dunn of the University of Pittsburgh. . . . Smart sign: A new electronic warning for railroad grade crossings can even tell whether a switch engine maneuvering nearby will actually move into the crossing or not.

ciency diseases afflicting the natives of poor countries are caused less by lack of food than by contaminated food—contaminated not with man-made insecticides but with poisonous chemicals from plants or molds. Beriberi (a serious vitamin deficiency) has been traced to a mold that destroys the food value of rice. Another mold found on rice can cause cirrhosis of the liver.

Computers to replace executives

The guy who really ought to worry

Profits That Lie Hidden in America's Mountain of Broken Electrical Appliances

By J. M. Smith President, National Radio Institute



And I mean profits for you — no matter who you are, where you live, or what you are doing now. Do you realize that there are over 400 million electrical appliances in the homes of America today? So it's no wonder that men who know how to service them properly are making \$3 to \$5 an hour — in spare time or full time! I'd like to send you a Free Book telling how you can quickly and easily get into this profitable field.

THE COMING OF THE AUTO created a multi-million dollar service industry, the auto repair business. Now the same thing is happening in the electrical appliance field. But with this important difference: anybody with a few simple tools can get started in appliance repair work. No big investment or expensive equipment is needed.

The appliance repair business is booming — because the sale of appliances is booming. One thing naturally follows the other. In addition to the 400,000,000 appliances already sold, this year alone will see sales of 76 million new appliances. For example, 4,750,000 new coffee makers, almost 2,000,000 new room air conditioners, 1,425,000 new clothes dryers. A nice steady income awaits the man who can service appliances like these. And I want to tell you why that man can be you — even if you don't know a volt from an ampere now.

A Few Examples of What I Mean

Now here's a report from Earl Reid, of Thompson, Ohio: "In one month I took in approximately \$648 of which \$510 was clear. I work only part time." And, to take a big jump out to California, here's one from

J. G. Stinson, of Long Beach: "I have opened up a small repair shop. At present I am operating the shop on a spare time basis — but the way business is growing it will be a very short time before I will devote my full time to it."

Don't worry about how little you may now know about repair work. What John D. Pettis, of Bradley, Illinois wrote to me is this: "I had practically no knowledge of any kind of repair work. Now I am busy almost all my spare time and my day off — and have more and more repair work coming in all along. I have my shop in my basement."

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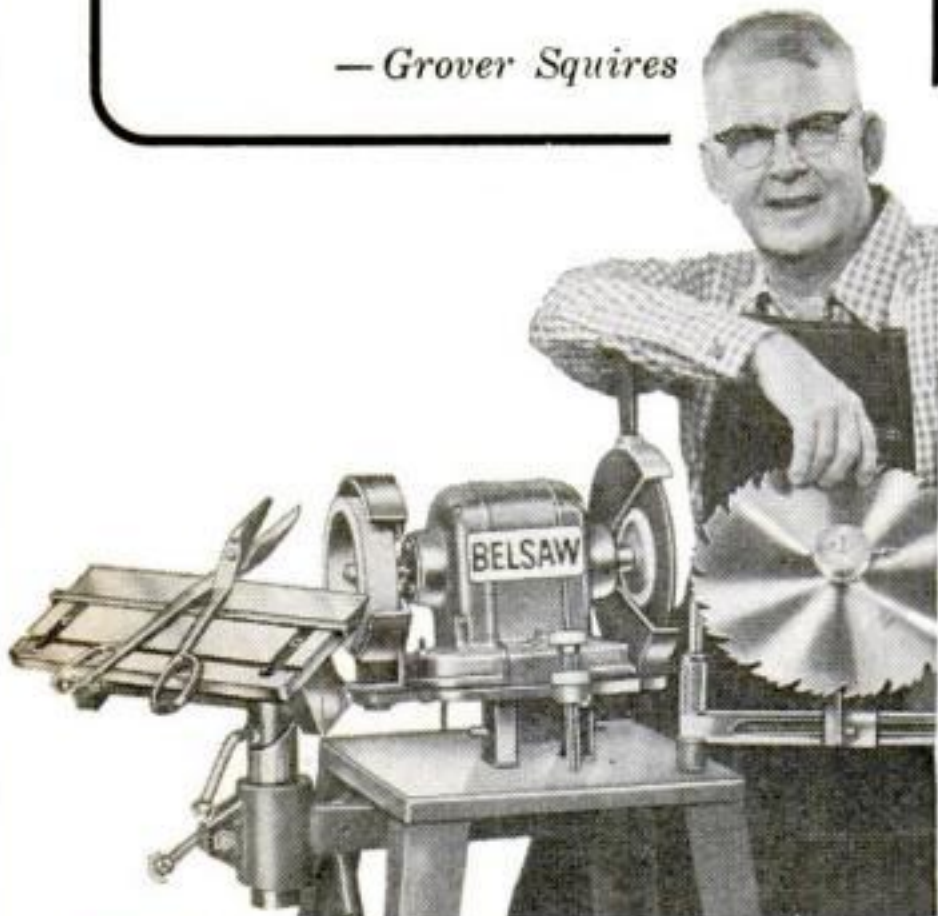
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The March of Science . . . continued

about losing his job to a machine is the boss, warns Prof. Thomas L. Whisler of the University of Chicago. For automation is beginning to take over the complicated but routine decision-making that is the province of second-echelon executives.

The manager of a steel warehouse, for example, must exercise a delicate control over his supply. If he orders too much from the mill, the cost of the investment in stock mounts. If he doesn't order enough, he runs out and loses sales. He must plot a course between these extremes by mulling over outside information: past patterns of demand, business activity, capacity of the mill. But now computers can take in these facts and spit out the answers, eliminating the need for the manager.

Professor Whisler's remarks back up other observers who think that in the long run automation will affect white-collar workers most seriously. Actually, most of the computers now in commercial use are already doing office work, not factory work. This has not yet reduced job opportunities because the de-

.....
 • **Ice shapes metal:** Republic Aviation seals a workpiece to a water-filled container, then freezes it. The expanding ice forces the metal against a die. . . . **Wine helps people reduce:** It calms them so that they stick to their diets, says Dr. Giorgio Lolli of New York City. . . . **New twist in charity:** A rummage sale of used industrial machines and tools netted \$71,533 for an art society in Detroit. . . . **Fluid gyroscope:** Spinning liquid replaces the wheel in a new Sperry space instrument. It has fewer parts and is cheaper.

mand for pencil-pushing has multiplied so greatly in recent years that there is more to be done than machines and people together can handle.

Laser's red ray (cont'd.)

Two new discoveries make the remarkable laser—the crystal that generates an ultrapure, ultraconcentrated

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The March of Science . . . continued

beam of light—seem better than ever for communications systems, even death rays.

RCA has operated a laser on sun power. The sun's rays, focused on a calcium fluoride crystal by a mirror, supplied the "pumping" energy that forces the crystal's electrons to emit light. This may solve the power problem for lasers in space, where light-beam communication would be most useful.

GE pulled a different trick with pumping: lasing a gallium arsenide crystal by feeding it plain electricity (no light energy). Currents that run to 130,000 amperes per square inch kick brilliant flashes of infrared from the crystal face. This method is very efficient, converting at least half the pumping energy into useful output and opening the way to superpowerful beams.

Go West? We've gone!

The most populous state in the Union, almost since the founding of the Republic, has been New York. No longer. Now this honor is jumping the continent to California. According to the Californians, the dramatic change has already taken place; they estimate a total population of 17,347,000 as of Jan. 1, 1963. New Yorkers, claiming almost that many citizens six months earlier, snort that the balance will not tip before summer. Nobody will know for certain until the next Federal nose count in 1970.

Cars best for commuting

A committee of experts told the Government what ordinary citizens seem convinced of already: The most efficient way to get in and out of cities is by car and bus. Even cars carrying less than two persons per trip are cheaper than train travel, says the committee, if the distance is not too short. Only the tremendous peak loads of New York City—800,000 commuters in the rush hours—warrant additional rail systems. Other large cities can haul their commuters most inexpensively over highways.

CONTINUED

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BRUCE P. SWINFORD started at \$3.35 per hr., operating tractor with scraper for Burns Const. Co., Indianapolis, Ind. He says: "Believe me I learned a lot at Northwest that some other fellows haven't yet after 40 years on the job."



PETE SCHOORDYK, JR. started operating a DW-10 scraper for McLaughlin Const. Co., Tacoma, Wn. at \$3.65 per hr. He says: "Your training gives the basic knowledge and experience that helps in getting a job and to keep it."



EARL B. LOEFFERS, Fontana, Cal., started as blade operator for Corona Asphalt Co. at \$4.01 per hr. He says: "I'll say this—all the study and training is coming in handy, more and more every day."



GENE H. WEISS, St. John, Wn., is self-employed as a general excavating contractor, earning \$8,000 per year. Gene states: "My only regret is not getting this type of schooling 10 years earlier."



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The March of Science . . . continued

The unbeatable fungus

The U.S. Public Health Service is crying uncle after a futile two-year effort to root some dangerous fungus out of park land in a town in Missouri. The fungus causes histoplasmosis, a flu-like disease, and lives in old chicken houses and other bird roosts.

It raised trouble in Missouri when Boy Scouts started clearing the park site from 11 acres of brush that had been home to thousands of starlings for 15 or 20 years. Four boys came down with histoplasmosis.

Public Health experts moved in. They cut and burned all the shrubbery, planted grass (to hold down fungus spores), sprayed with all kinds of poisons. The fungus is still there, growing six inches down into the ground. It is still infectious, even when the ground is frozen and covered with snow.

Admits the U.S.P.H.S.: "How to kill it remains a mystery."

Madaline, the adapting machine

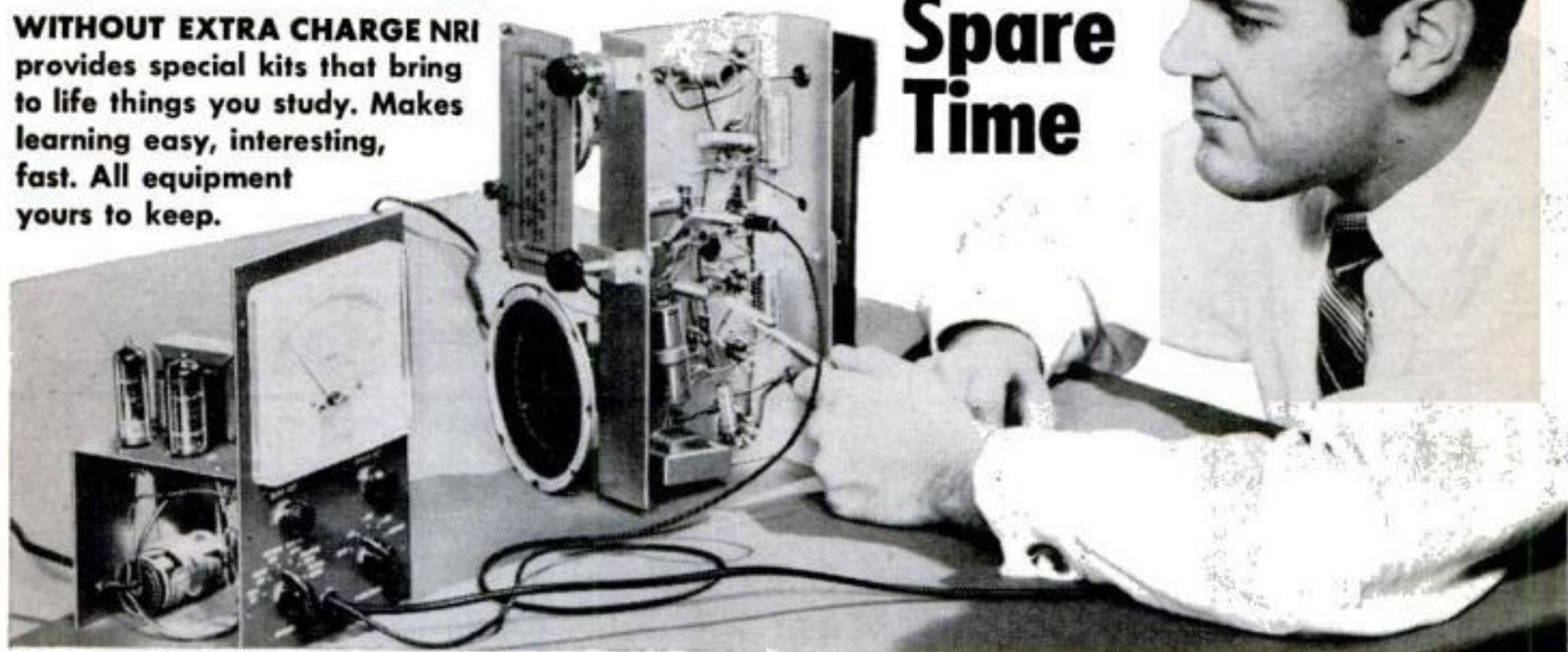
Stanford University scientists have built an electronic computer that learns to get along with its own defects. When first put together, it contained parts that did not operate—misconnected wires, shorts, and open circuits—yet it worked well when turned on. Such manlike adaptability is desperately needed for space-rocket systems, which often wreck a multimillion-dollar shot when a single relay conks out.

The Stanford computer, called Madaline, is designed to take in information from photocells or microphones and figure out what it is supposed to do, even if the problem is not exactly like those it has been programmed to solve. It is one of several attempts, under way at a number of laboratories, to build machines that will not need advance programming in machine language, but can be taught basic procedures in ordinary language. They will solve problems just like men.

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President

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JULIUS HILLENBRAND, Brooklyn, N.Y.



After graduating I was a shipboard radio operator. Now I am chief engineer at Station WARA.
RAYMOND D. ARNOLD, Attleboro, Mass.



Thanks to NRI I am in a top position with the Federal Aviation Agency in the Navalds Electronic Section.
JOE DUCKWORTH, Fort Worth, Texas.
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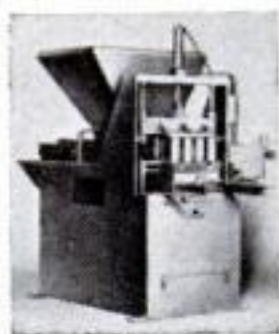


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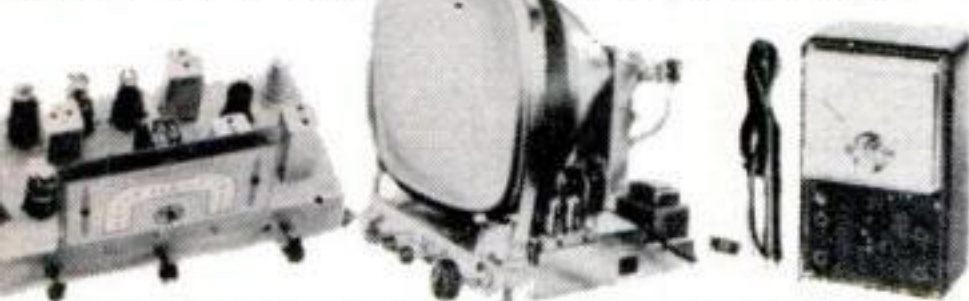
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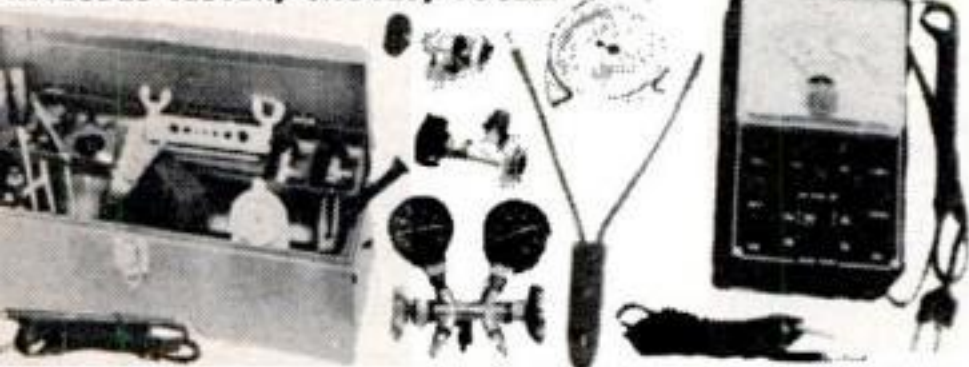


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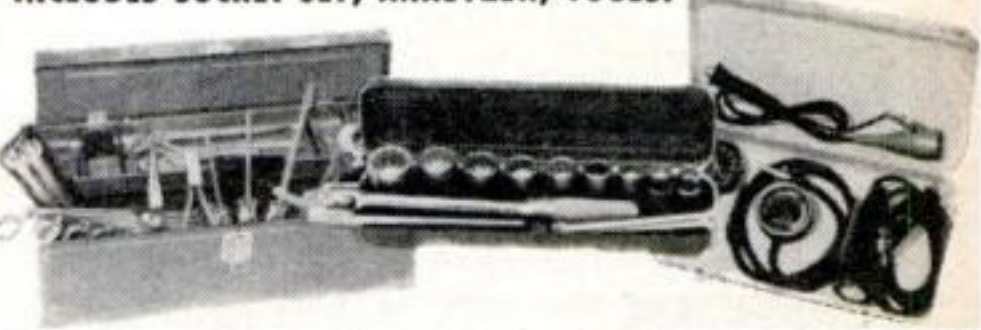
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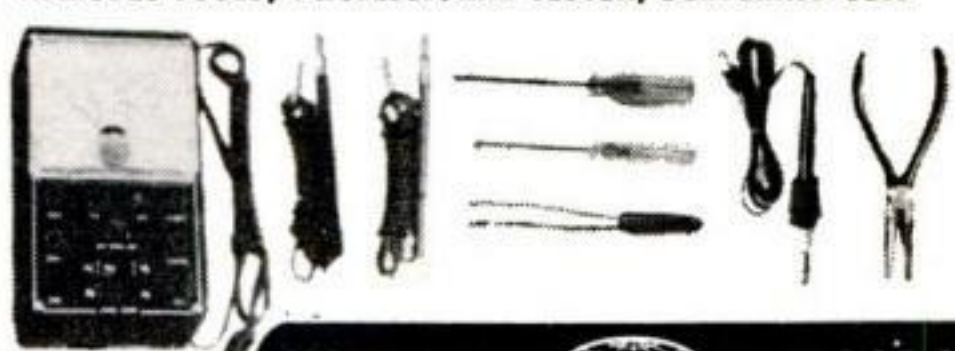
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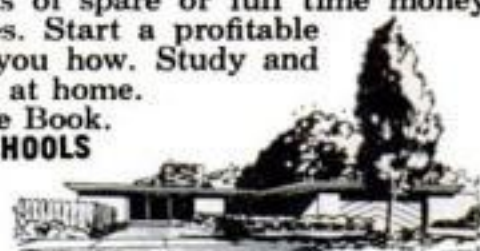
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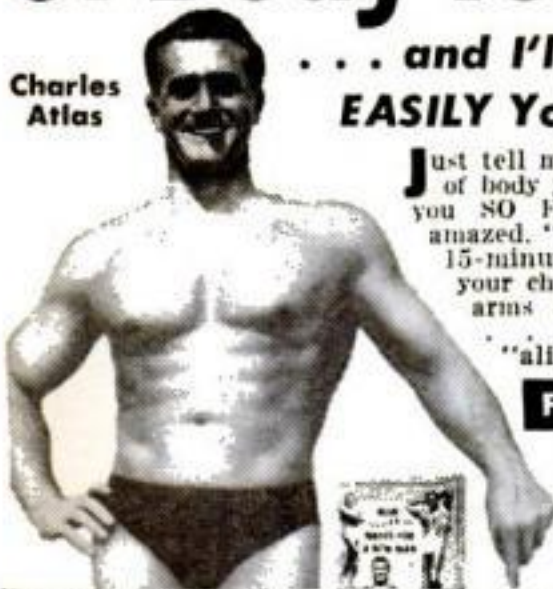
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In addition to cleaning you make added profits on five other wonderful services! A quick spray with **DURASHIELD** retards soil and stains... keeps fabrics fresh and bright much longer. Another spray with

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A small dealer just starting and doing his own service should gross \$180 profit from only 20 hours service in a week. If he uses 30% for advertising, etc., he nets clear \$125. If he services 40 hours, his net profit is \$250.

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L. Broersma: "Have now completed 5 years with Duraclean. We have never had one complaint."

George Byers: "For University, bill was \$2,416. Total expenses \$814."

Ed Kramsky: "In 2 years, I now have two assistants, a nice home and real security for my family."

L. Babbit: "I average \$400 monthly part time. I'm starting full time."

Russ Day closed 19 jobs from 21 contacts.

W. C. Smith: "Earned \$650 one week. Volume keeps getting bigger."

L. Falls: "I cleaned 1,900 sq. ft. of carpet in one day. Made \$135."

Earl Davis: "Our sales increased \$17,660.00 this year."

A. Nebendahl: "Closed every sale where I used new slide projector."

N. Josseland: "Have made as high as \$200 in one day. Largest earnings for a single week, \$750."

Fabric Mills Endorse YOUR Service

Aldon Carpet Mills: "We approve this process. We are pleased with the texture restoration."

Patcraft Mills: "Fibers are not soaked by Duraclean. Best method of cleaning we have seen on tufted carpeting." **Croft Carpet Mills:** "The Duraclean method is superior."

Trendline Upholstered Furniture: "We recommend Duraclean as the safest and most effective method of cleaning fine furniture." **Kingston Mills:** "It is our intention to recommend Duraclean Service."

Modern Tufting Co. "Duraclean is superior to any on-location cleaning process with which I'm familiar."

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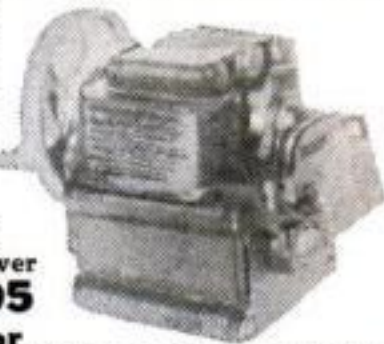
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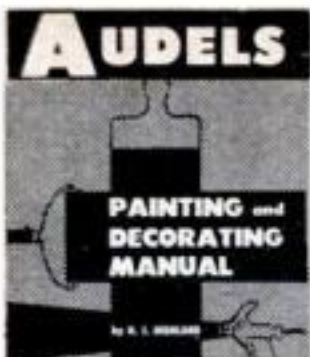
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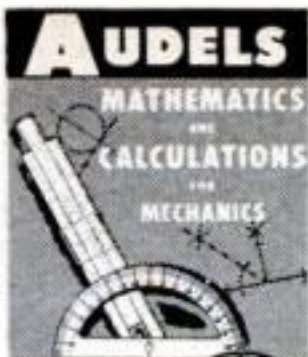
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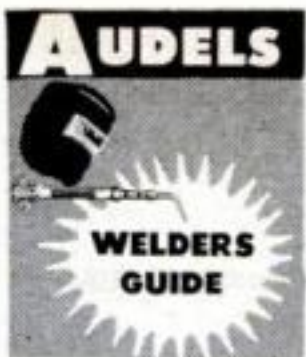




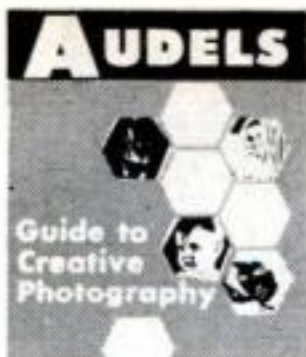
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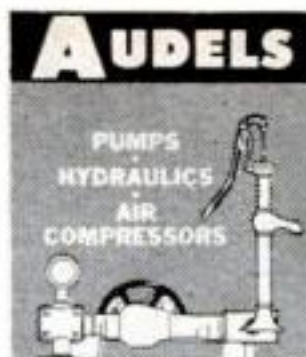
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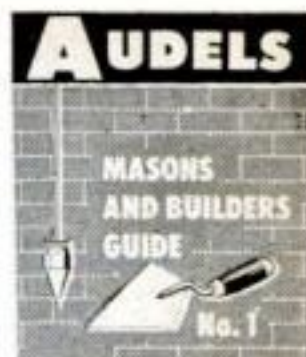
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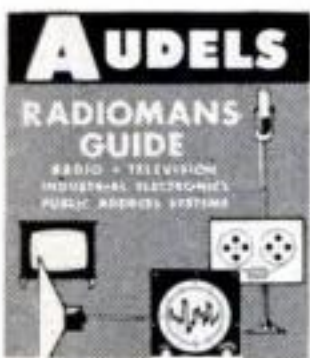
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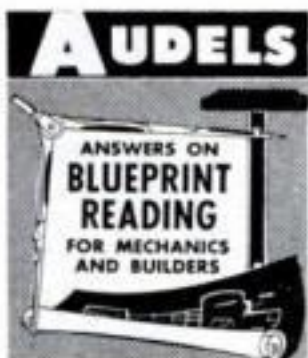
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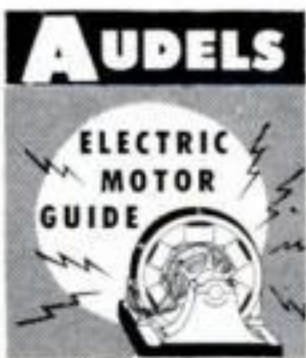
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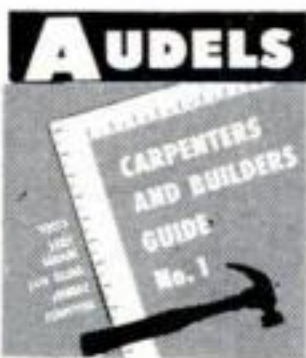
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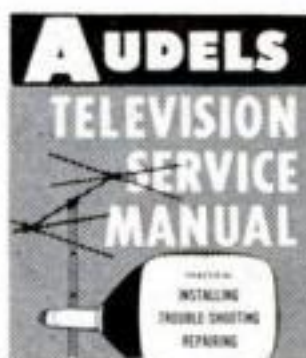
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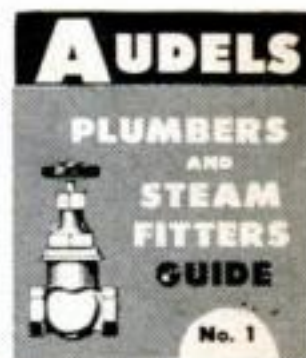
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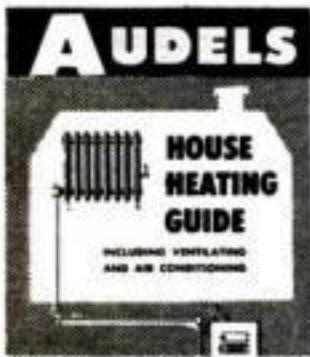
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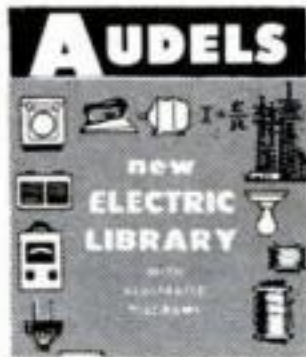
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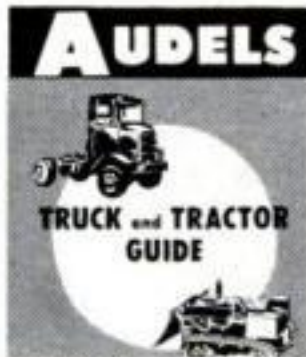
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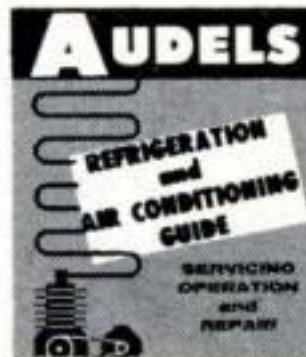
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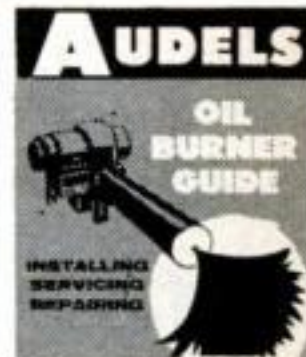
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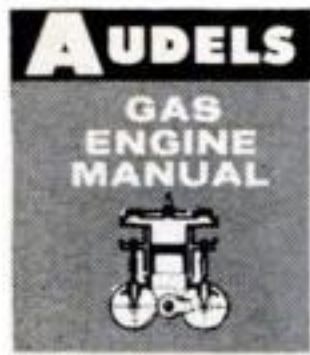
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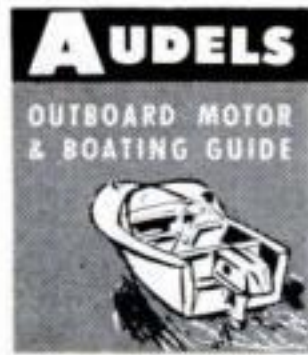
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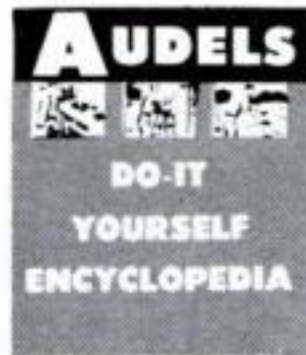
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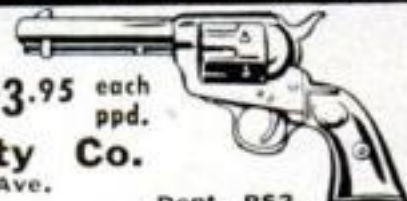
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Getting Ahead

By Dr. Lewis R. Fibel

A monthly column to help you prepare yourself for a better job

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Ask for the second edition of its directory, *Educational Programs and Facilities in Nuclear Science and Engineering*.



Where are the jobs going to be?

Today, government and industry employ 900,000 engineers.

In 1971, they'll need 1,300,000... but they won't have them.

Technicians fill the bill in many cases... but only 17,000 graduate every year,

less than  1/2 technician for  1 engineer when the figures should be four times that:

 2 technicians for  1 engineer.

Moral: A word to the wise...

(Source: Engineering Manpower Commission of the Engineers Joint Council.)

"Criminalistics," "correction," and "law enforcement" are samples of the professional-correction curriculums available at 175 different schools in the U.S. and Canada. The American Correctional Association (135 E. 15th St., NYC 3) offers a complete directory of schools and programs. Included are 44 junior colleges that give associate degrees or certificates.

Radiation technology courses, day and evening, are offered at Montgomery Junior College, Takoma Park, Md. They'll prepare you for a job assessing radioactive hazards or monitoring radioactive isotopes, nuclear reactors, or fallout. The National Advisory Committee on Radiation estimates that 4,000 radiation technicians will be needed by 1970 for jobs in labs, industry, and government.

"I'm a high-school graduate with a general diploma. How can I enter a skilled trade such as die making?"—B.D., Pittsburgh.

There are many routes, but most young men become apprentices, work up through journeymen, and then become skilled craftsmen. The most common type of apprenticeship, and the one recommended by the Bureau of Apprenticeship and Training of the U.S. Department of Labor, involves a system in which the trainee is given instruction and experience, on and off the job, in all aspects of the work. The off-job training may be given at a local trade or vocational school or through correspondence courses. Most state departments of education supervise apprenticeship programs in their state, usually with the aid of an advisory committee made up of management and labor.

Application for apprenticeship may be made directly to an employer, or to the local offices of the trade union, the joint apprenticeship committee, or the state employment service.

"Could you recommend a school that offers correspondence courses in time-and-motion study?"—M.J.T., Falls Church, Va.

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- 2.** Enroll. Study your I.C.S. texts (as more than 100,000 other adults will tonight). See how easy it is to pick up practical facts when they're presented by authors who are recognized authorities in your area of interest. Heed the personal notes from your expert instructors.
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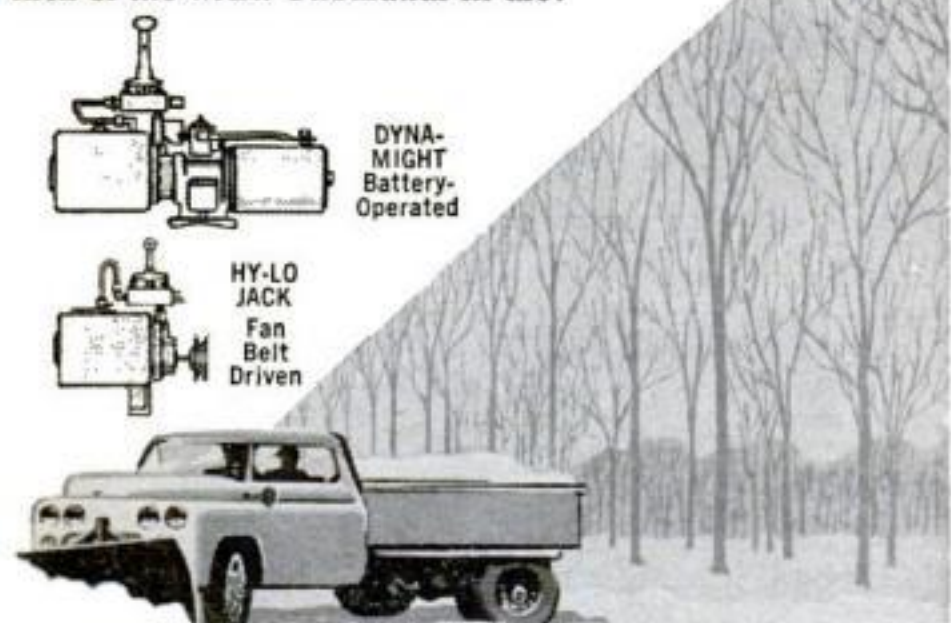
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“What are the general requirements for someone who wants to be a draftsman? How much education do you need? What are the chances for advancement?”—R.T.S., Waterbury, Conn.

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There are no formal requirements for drafting jobs, but high-school graduation and some specific mechanical-drawing training is usually expected. Most firms will look for young people who have had additional training in technical schools, junior colleges, or by correspondence.

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Advancement generally requires some designing ability. Here advance work in mathematics, physics, or other fields is desirable.

“Are there post-high-school courses in aircraft maintenance?”—L.V., Tulsa, Okla.

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Not every question may be used. Questions cannot be answered by individual letters.

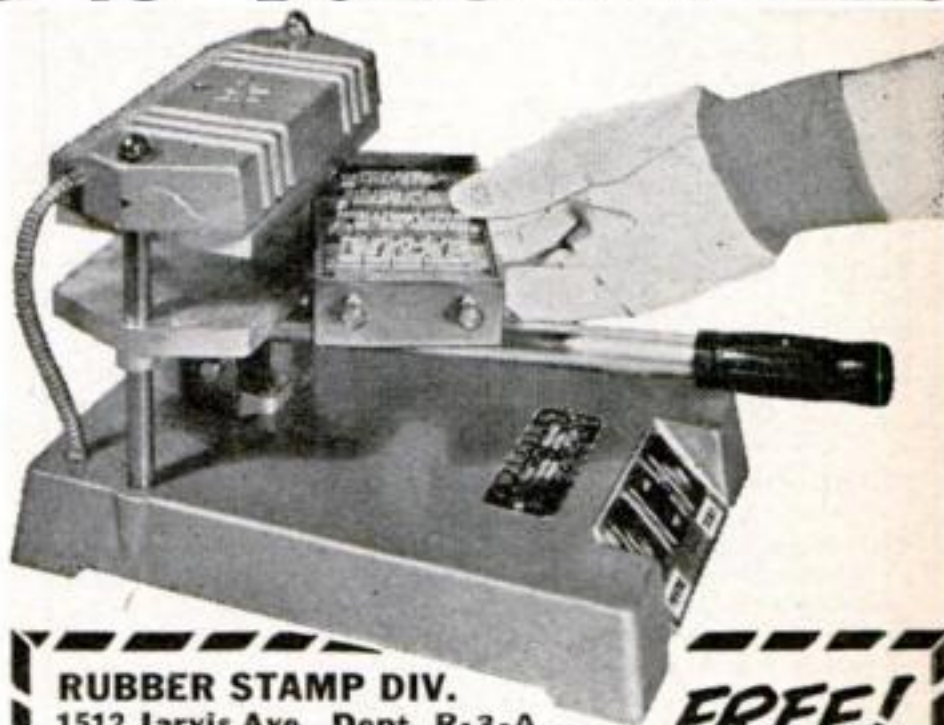
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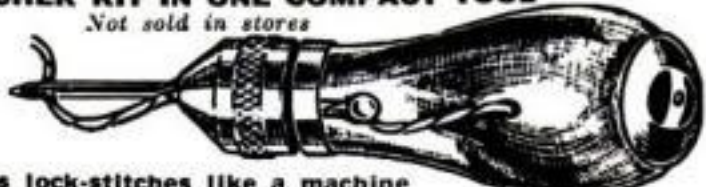
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"Now, according to M. Jobard, a 300-year old paper has been found which contains a clear explanation of photography. The alchemists understood the properties of chloride of silver in relation to light, and its photographic action is explained by Fabricius in 'De Rebus Metallicus' in 1566."



"The cultivation of the opium poppy in France is steadily increasing. It now occupies 50,000 acres, yielding opium worth two million francs a year."

1903 "No discovery in recent years has aroused more interest among biologists than Mendel's Law. This states that in the second and later generations of a hybrid every possible combination of the parent characters occurs, and each combination appears in a definite proportion of individuals.

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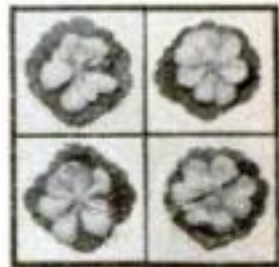


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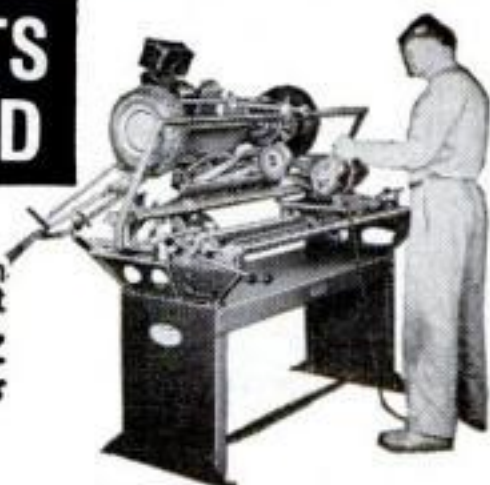
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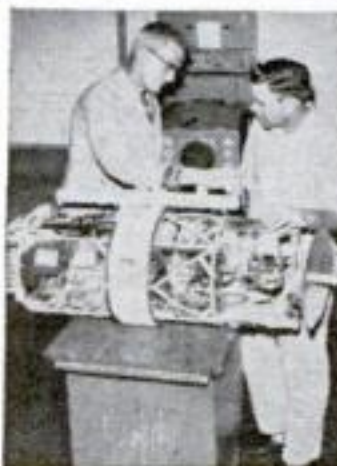
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Detroit report

By Devon Francis

Freeze-out on an antifreeze

Notice the lack of emphasis on "permanent-permanent" antifreeze this winter? There's a reason.

For two years a battle on antifreezes has been waged among three giants of the chemical industry. Union Carbide stiffened its neck a couple of years ago when Dow Chemical introduced an extended-life antifreeze good for a couple of winters. They didn't believe in it. But a third company did: Du Pont, too, launched a campaign to sell the long-life antifreeze to car makers.

Union Carbide's strategy was to introduce a long-life antifreeze also, but to emphasize its regular (plain permanent) antifreeze in its advertising. Its recalcitrance apparently has paid off. The campaign for long-life antifreezes appears to be over.

Main reason? Most "permanent-permanent" antifreezes are poured at the factory when a car is made, and sealed in. Motorists like to put in their own.

Glue—for lighter bodies

Take a close look at the windshield and rear window of the '63 Buick Special and Riviera, Olds F-85, and Pontiac Tempest. A change has been made to a new glazing system developed by GM's Fisher Body division, aided by a supplier. The idea was tried out experimentally on the F-85 for 1962. Now it's spreading.

For decades, windshields and back windows were inserted in slotted rubber moldings. Fisher has now substituted a polysulfide product made by Thiokol. Resembling a heavy glue, it is put around the window frame in liquid form and the glass positioned in the body.

When the body is baked after painting, the polysulfide becomes rubbery. Because it adheres to the glass so tightly,

the glass actually becomes part of the body structure. The prospect: less upper-body steel, lighter cars. Ford will have something of the same kind on a limited number of cars this year.

Those turbocharged engines

Been wondering how the Olds and Chevy turbocharged engines are going on the salesroom floor? The figures are in.

Olds sold 3,765 turbochargers on its F-85 models in six months of the '62 model year. In the first 90 days of '63 it sold 2,569—one out of every eight F-85's was so equipped. Chevy started out for '62 equipping only one out of every five Corvair Monzas with a turbocharger. Now it's up to one out of every 3½ Monzas.

Latest tips on insurance

Collision insurance covers any car you borrow, even if the owner isn't insured.

Clauses covering auto theft apply only to the car and its components—if a camera, for instance, is stolen from your car, it's your loss.

You can buy liability on genuine antique cars at a 75-percent reduction provided they are used solely in exhibitions, club activities, and parades.

If you have a medical-reimbursement policy, you can collect if you are struck by a car while walking.

Three states—New Jersey, Maryland, and North Dakota—have special funds from which residents can collect for injuries inflicted by an uninsured motorist.

Liability insurance is good on a car in a car pool, and for all members.

Insurance companies have begun to think again about that extra break for female drivers. The gals under 25 pay the same rates as adults 25 and over—while whopping extra premiums are asked for males under 25. But now there are just getting to be too many female drivers. The low rates have been due to fewer girl drivers and therefore low accident-exposure—not, it seems, to better driving.



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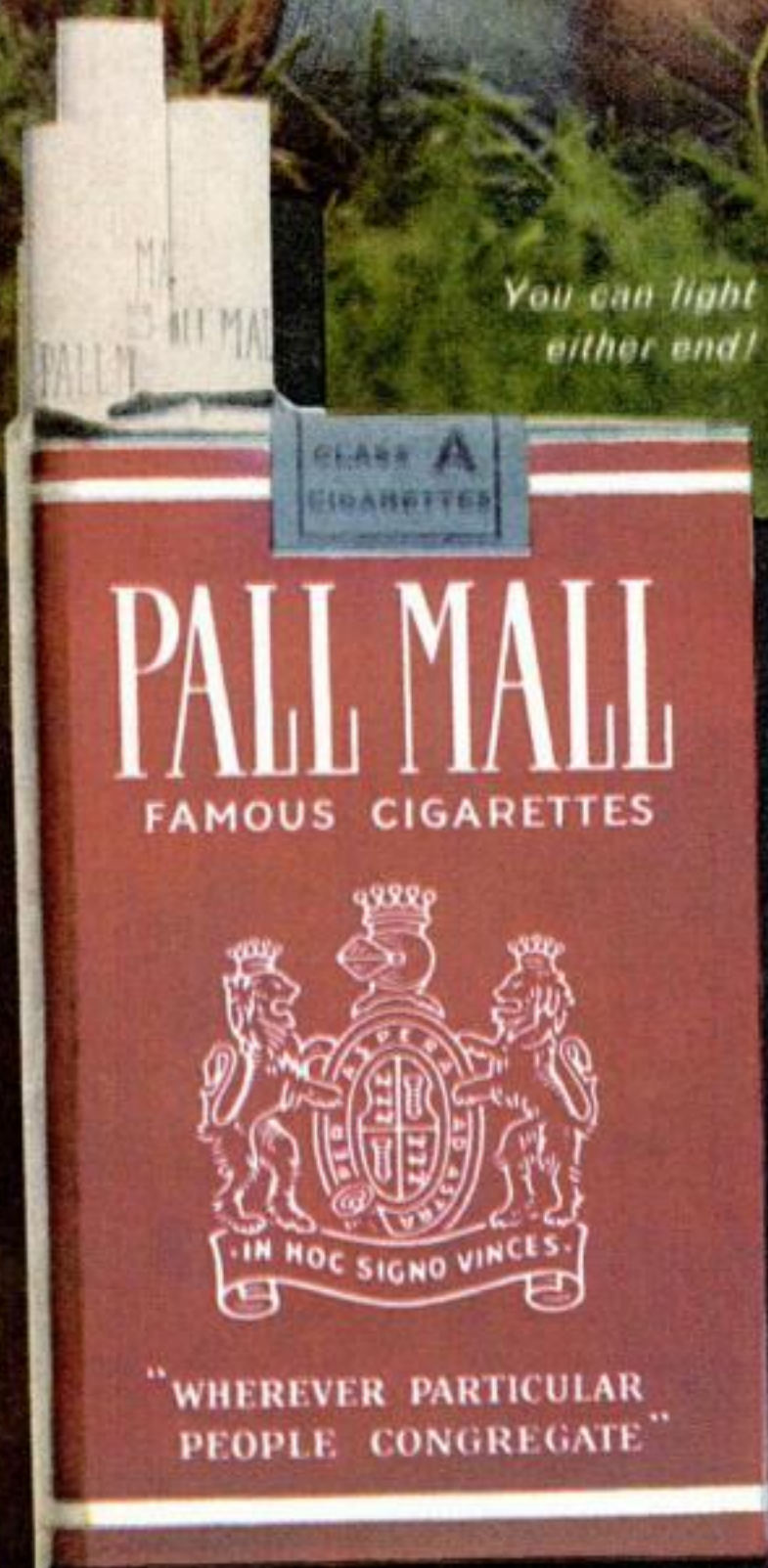


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Our Most Important Announcement in 91 Years

BEFORE this decade is out, the President of the United States has promised, we shall have placed an American on the moon. The man in charge of the big rockets for this job is Wernher von Braun.

The announcement that Dr. von Braun will become a regular contributor to POPULAR SCIENCE is the proudest statement this magazine has made in the 91 years it has been reporting the progress of science.

Now director of the National Aeronautics and Space Administration's George C. Marshall Space Flight Center at Huntsville, Ala., Dr. von Braun was named technical director of the Rocket Development Center at Peenemünde, Germany, in 1937, at the age of 25. Under his direction, Peenemünde developed the liquid-fuel V-2.

In September, 1945, Dr. von Braun and more than a hundred associates were brought to the United States to continue their rocket experiments at Fort Bliss, Tex. Most of them moved to Huntsville in 1950. There they have been credited with such achievements as the launching of the first U. S. satellite, Explorer I, and the suborbital flights of Astronauts Shepard and Grissom, whose Mercury capsules were launched by a modified Redstone, our first big ballistic rocket.

Born in Wirsitz, Germany, in 1912, Dr. von Braun studied engineering in Germany and Switzerland, and was awarded a Ph.D. in physics in 1934 from the University of Berlin for a thesis on liquid-fuel rockets. He became an American citizen in 1955.

Robert P. Crossley
EDITOR

Wernher von Braun Answers Your Questions About Space

Why I am writing for Popular Science



IF MY daily mail is a suitable yardstick, space science is a popular science indeed. I would not be able to get any other work done were I to try to answer systematically all those questions that find their way to my desk.

POPULAR SCIENCE'S invitation to write a monthly column on my favorite subject was thus received as both challenge and relief.

Challenge, because it always intrigues me to reduce a complex problem to terms that (I hope) anyone can understand. Relief, because I am frequently bothered by a bad conscience for not having replied to some of the most enthusiastic, inquisitive, curious, and penetrating letters.

Space science isn't like geography, or astronomy, or physics, or chemistry, or medicine. It is a little bit of all of them and more. That is what makes it so fascinating.

But it is this kaleidoscopic aspect of space science that makes it almost impossible to "organize" a monthly column such as this. Mr. Crossley and I have therefore agreed not even to try to arrange the questions and answers in any systematic way. If the result is a bit disjointed, it should at least be colorful.

Karl von Braun

How do you steer a rocket?

Q *How are large rockets steered during powered flight?*

A All methods have one principle in common: The rocket exhaust is deflected in a controlled fashion.

For a rocket to fly straight, the force of its thrust must be so aligned as to point to the rocket's center of gravity. If the thrust force F is out of alignment and passes the center of gravity at a distance L , a turning moment will result that is equal to $F \times L$. A large rocket is steered by shifting this turning moment to the right and left (controlling yaw), or up and down (controlling pitch), depending on which way we want it to turn.

The force of a rocket's thrust is always parallel to that of the flow of exhaust gas, but acts in the opposite direction. In a liquid-propellant rocket, the combustion chamber with the exhaust nozzle is usually swiveled to and fro like the outboard motor of a small boat. The swiveling forces are provided by hydraulic actuators (oil-driven pistons) which are controlled by electrical signals from the rocket's control computer.

Older types of liquid-fuel rockets were often controlled by jet vanes. Usually there were four relatively small rudders of graphite, tungsten, or an ablative material—one whose expendable outer surface is allowed to char or volatilize—that were immersed in the main jet and rotated by electric actuators. Jet vanes do not deflect the entire jet but only part of it. The effect of a jet vane can be compared with that of a rudder located in the propeller down-wash of a larger in-board motorboat.

Steering solid-fuel rockets

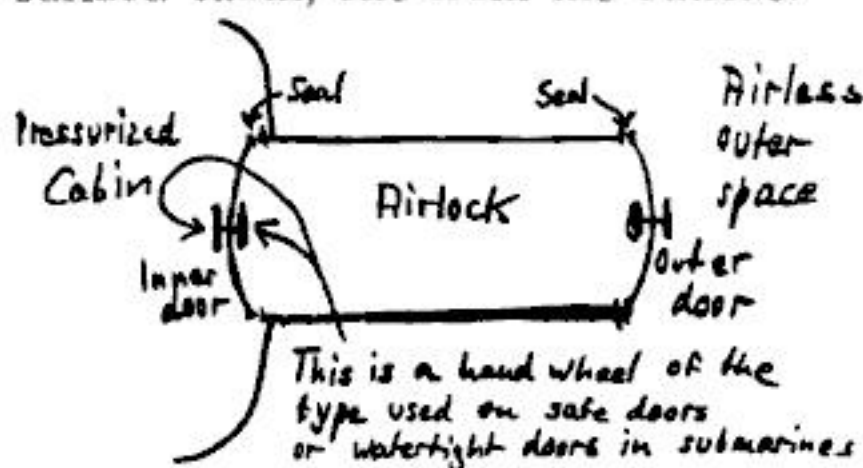
Unlike liquid-fuel rockets, solid rockets do not have separate thrust chambers. In a solid rocket the basic airframe serves simultaneously as propellant-storage container and thrust chamber, and swiveling the thrust chamber would not be feasible. For this reason designers of

Leave a capsule in space? Here are answers by Dr. von Braun

solid rockets have developed deflectable exhaust nozzles. Often a single solid rocket discharges its exhaust gas through four parallel-mounted swivel nozzles, permitting complete three-dimensional control in the up-and-down (pitch), the right-and-left (yaw), and the rotational (roll) directions.

Q *How does an astronaut enter or leave his pressurized crew compartment in airless outer space?*

A By means of an air lock. This is a sealed compartment with access through two airtight doors, one from the pressurized cabin, one from the outside.



When leaving the cabin, the astronaut, clad in his pressurized space suit, enters the air lock, closing the inner door behind him. He now depressurizes the lock either by venting the air to the outside or by pumping it back into the cabin.

Once this is done, the pressure in the air lock is down to zero and equal to that of outer space. He may now open the outer door and leave his spacecraft.

Returning, he enters the nonpressurized lock through the outer door, closes it, and repressurizes the lock by opening a valve connecting it with the pressurized cabin. After the pressures of cabin and lock have been equalized he may open the inner door and enter the cabin.

For outside inspection: an air lock

Air locks will be used in advanced spacecraft (such as Apollo) to enable astronauts to leave their pressurized cabin temporarily. This may be desirable for outside inspection, docking maneuvers, rescue operations, and for crew

transfer into another vehicle such as the lunar-excursion "bug" designed for the letdown from lunar orbit to lunar surface.

Q *Why is liquid hydrogen such a good rocket fuel?*

A There are two reasons. One is the high heat energy released by the combustion of hydrogen. The other, equally important but less obvious, is the low molecular weight of hydrogen and its combustion product, water vapor.

The exhaust velocity of a rocket engine is the best yardstick of its fuel economy. Each gas molecule spurting from a rocket motor's exhaust nozzle can be looked upon as a tiny bullet fired from a gun. The higher the muzzle velocity, the more recoil will be exerted on the gun barrel. As the thrust of a rocket motor is made up of the total of all the little recoils produced by millions of molecule bullets, and the exhaust gas is produced by burning fuel, it follows that the higher the exhaust velocity with a given amount of fuel, the greater will be the rocket motor's thrust.

For high velocity: hydrogen

The exhaust nozzle of a rocket motor can be looked upon as a device that orients the all-directional movement of the gas molecules in the combustion chamber into one predominant direction. The exhaust velocity is, therefore, directly related to the velocity at which the gases whirl around in the chamber immediately after combustion but prior to entering the exhaust nozzle.

Now a fundamental law of physics states that *at a given temperature the average kinetic energy of the whirling molecules of any two gases must be the same*. The kinetic energy, or energy of motion of a body, depends on two factors: its weight (or mass) and its speed. This means that in order for a light and a heavy body to have the same kinetic energy, the light one must be faster. It

More answers by Dr. von Braun: Dead moon? Erupting sun?

follows that, for a given combustion temperature in a rocket engine, the propellant combination that produces lighter exhaust products will also produce a higher exhaust velocity.

Of course, a high combustion energy is needed to obtain a high combustion temperature. The combustion of hydrogen is one of the most powerful reactions known in chemistry. But, as we have seen, a light combustion product with a low average molecular weight is equally important. Hydrogen, with a molecular weight of only 2, is the lightest gas in existence. Even its combustion product, water vapor, resulting from reaction between two hydrogen atoms and one oxygen atom, has a molecular weight of only 18, which is quite low compared with that of combustion products of other fuels. Moreover, rocket engines using liquid hydrogen as fuel and liquid oxygen as oxidizer operate at maximum efficiency when running at a fuel-rich mixture. This means there are more hydrogen atoms around than there are oxygen atoms available with which they could react. The exhaust jet of such a rocket engine is therefore composed of a mixture of water vapor and unburned hydrogen, with a molecular weight somewhere between 18 and 2. It is because of these advantages that rocket engineers put great faith in liquid hydrogen.

Q *Is the moon a dead world?*

A It is certain that the conditions on the lunar surface are prohibitive for any kind of higher animal or plant life. It is not impossible, however, that soil bacteria might exist on the moon, and we have no way of knowing whether there are subterranean deposits of ice that might be capable of supporting certain low forms of growth.

Some lunar craters are the center point of raylike features. These light-colored bands, sometimes several hundred miles long, seem unaffected by terrain over which they pass. Astronomers conclude

they are made by dust thrown up by volcanic explosions or by volcanic gases frozen to the lunar soil.

Q *What are solar flares?*

A Although the sun seems never to change in appearance, it is actually subject to erratic behavior. Its surface may be perfectly clean today; a month later it may be covered with dark spots. Sun spots are an indication of activity that bears some resemblance to volcanic eruptions on earth. The difference between the two phenomena is that the gas expelled by the sun—predominantly hydrogen—is so hot that the hydrogen atom (consisting of a proton and an orbital electron) is deprived of its electron. As a result, the solar gasburst, or flare, consists of protons or electrons.

Under "quiet" conditions, there is a more or less steady flow of these particles, called "solar wind." This flow travels all the way from the sun to the earth and beyond. During average solar eruptions the density of this flow increases a hundred-fold or more, and the velocity at which the particles reach the earth is also markedly higher. Once a year or so the eruption of a gigantic flare is observed, with particle densities and speeds far exceeding those in normal flares.

For manned space flight, only these giant flares are considered hazardous. A program to predict such flares has been initiated, and it is planned to time short trips (such as round trips to the moon) so that they won't coincide with the superflares. On long interplanetary space voyages it may be necessary to take along "storm cellars," into which the crews could withdraw during the hours of peak intensity of the flare. ■ ■

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Dr. von Braun will consider answering questions from readers of **POPULAR SCIENCE** in the magazine, but he cannot undertake to answer each one by mail. Letters to him should be addressed in care of **POPULAR SCIENCE**, 355 Lexington Ave., New York 17, N. Y.

Coast to Coast in a Dodge Motor Home



Four people and a pooch discover some weird things about living in a house on wheels

By Devon Francis

MIND you, I am not one to start arguments before breakfast, but on this particular morning I figured I had to lower the boom on my wife.

"Why," I asked her, trying to sound civil, "are you putting a mop in the car?"

"For the floor," she answered, looking innocently wide-eyed as usual.

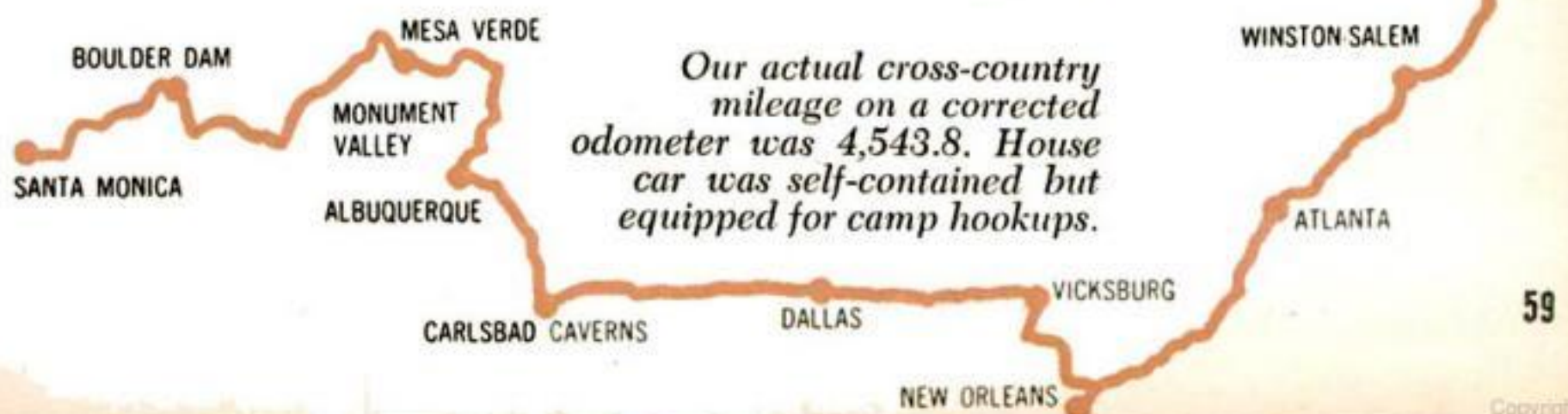
"And the cage for the dog?"

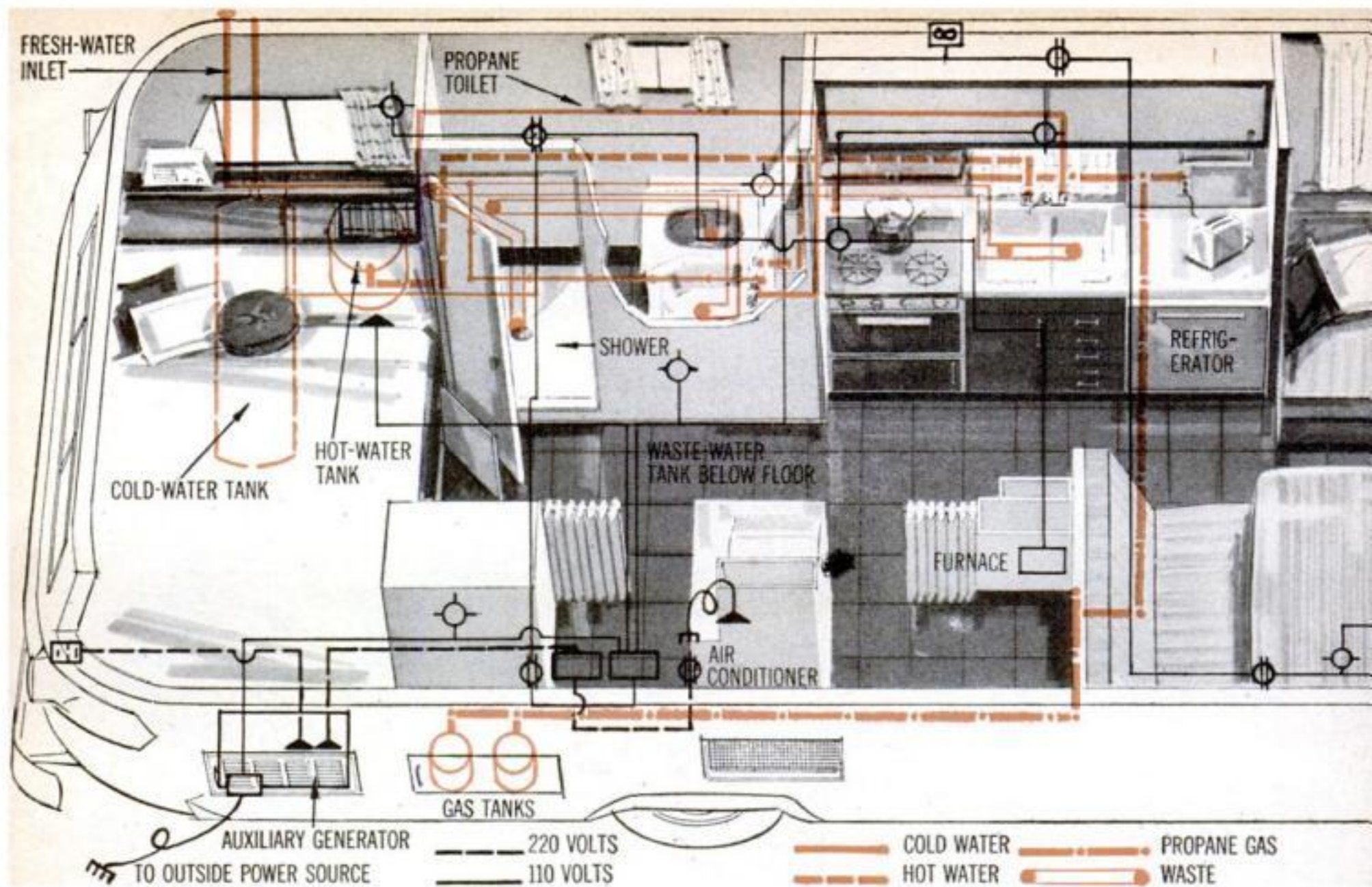
"To ship him back from Los Angeles." She added firmly, "The dog is going along."

Motor Home rolls down Santa Monica's Wilshire Blvd. at journey's end. Gas mileage averaged 7.87—including 57 hours' operation of auxiliary generator off same tank.

Gas-oil cost per mile: \$.0437. Top speed: 69 m.p.h. on 4.88:1 axle. Zero to 60 m.p.h. took 33 seconds

CONTINUED





A miniature home, the \$9,750 vehicle has elaborate water, propane, and electrical systems.

Well, you can't fight city hall, as the saying goes, and I grumblingly loaded luggage, tools, and sundries, checked the tire pressures, and explored a rocker-panel storage bin while she put a ton of supplies, more or less, into the vehicle. There is one thing you can say about Rosemary: When she starts a trip in a car—any car—we could never rent out our home furnished.

We were going to drive several thousand miles in a house car. A house car is not a car. It is not a trailer. It is not a truck. Yet it's sort of both trailer *and* truck—or a bus. It's a house built on a truck chassis. In short, it's the newest thing in self-contained mobile homes.

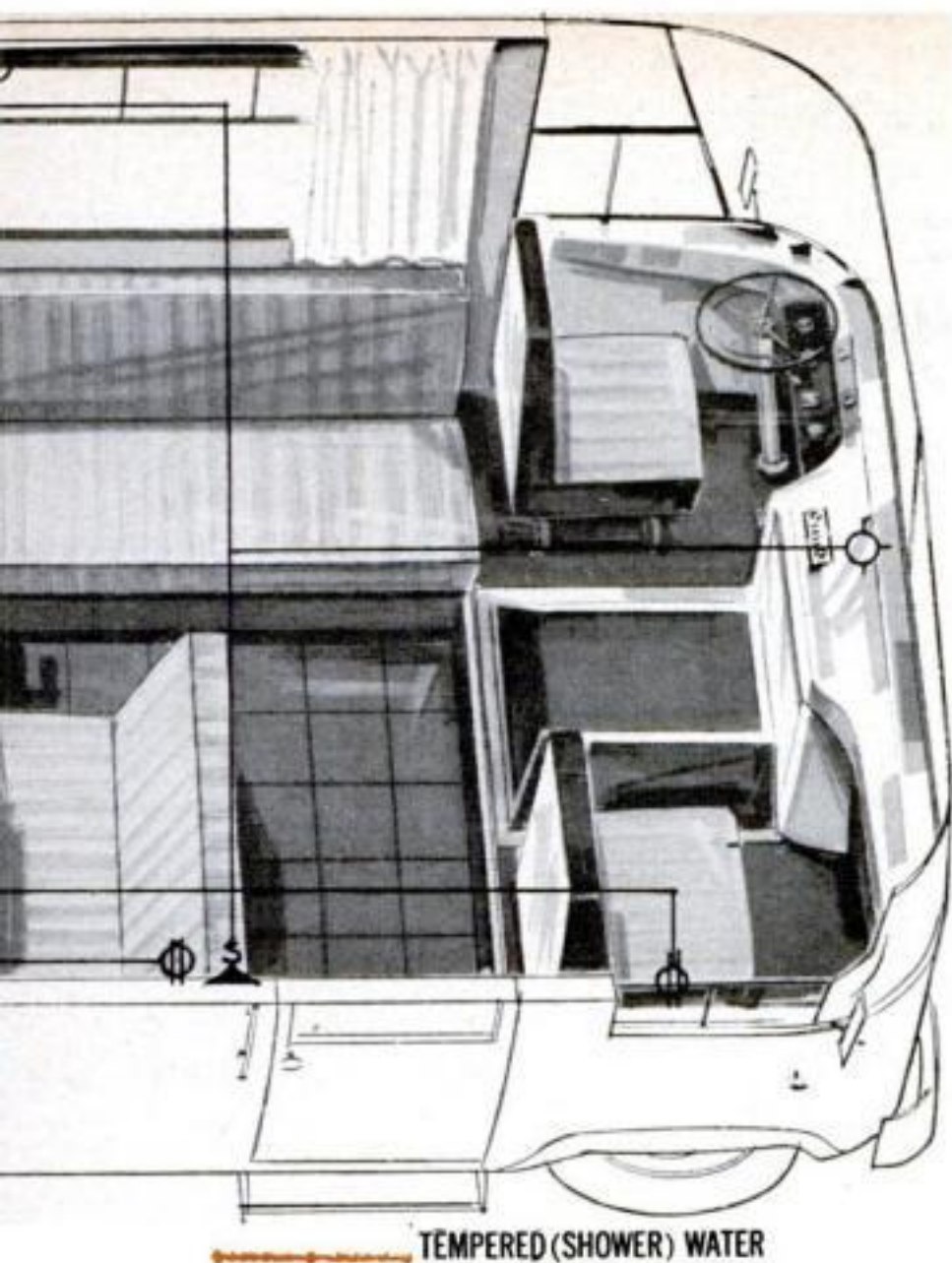
The Dodge Division of the Chrysler Corp., which had urged it on me, to the delight of my wife, calls it a Motor Home. Reluctantly I had accepted the vehicle to deliver it in Los Angeles. I had never driven a truck or bus, or hauled a trailer, and I couldn't have cared less for the experience.

So here we were, on a sunlit morning

in White Plains, N. Y., with a blue jay calling raucous instructions from one of our oaks, getting ready to drive 4,500-odd miles to California the long way 'round—by way of New Orleans and then clear up into the Utah-Arizona Monument Valley. The dog-leg to Louisiana had a purpose—we were to pick up my father- and mother-in-law there and tote them west with us.

The works. You could live and die in this vehicle without going outside its door. It had everything: fresh water (heated for a bathroom shower and dish-washing); a gas-fueled icebox; more storage space for clothes, food, and household goods than we could use; a furnace; a stove complete with oven; an auxiliary electricity generator (to supply, among other things, current for a portable TV that I thoughtfully had brought along); a toilet; the inevitable radio; and an ailing air conditioner that could just as well have been left behind.

We had two axles but six wheels, four in the back. Mobility was provided by



Auxiliary battery heats water.

a 200-horsepower engine, mounted low between the two front seats. We had power steering, power brakes, and an automatic transmission.

"We're ready," announced my wife at long last from the car door.

I climbed aboard for my first surprise. On the table were orange juice, poached eggs and bacon, toast, marmalade, and coffee.

"Our first meal in the Motor Home," said Rosemary.

Well, anyway, the stove worked.

We rolled gingerly across a Hudson River bridge, paying the regular passenger-car fare of 50 cents, and pulled up at the entrance to the New Jersey Turnpike.

"You a trailer?" asked the man in the booth.

Schnapps, our miniature schnauzer, snarled.

"I'm a house car," I said, shushing the dog.

"Trailers are barred today," he said. "Wind's too high. But I guess you're okay."

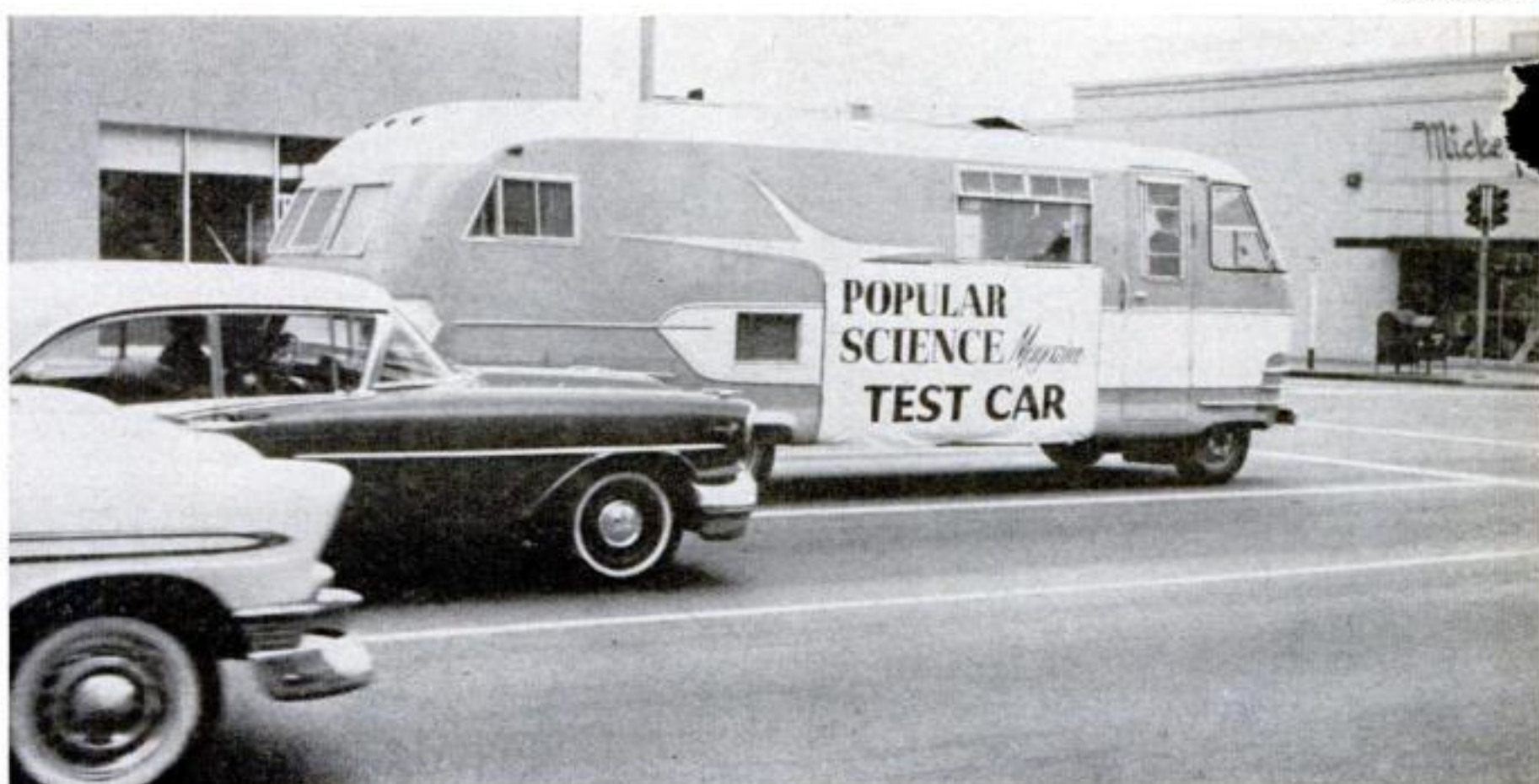
That was a plus. We had another advantage—most states won't allow trailers to be occupied on the road.

I accelerated to the legal 60 miles an hour and promptly got my first lesson in house-car driving. With its bulk and slab sides, it was a handful in wind at anything over 50. I slowed down.

My clearances kept bothering me.

"Are you watching the right side?" I asked Rosemary. "Where's the edge of the pavement?"

CONTINUED



Driving in traffic is no problem—other motorists give you a wide berth, wide-eyed looks.

These were the things we liked most about the house car



Kitchen, with ample storage for food, good stove and refrigerator, was a joy three times a day. We cooked roasts while under way.



There was elbow room for four persons at the table. A vacuum-operated pump put 75 p.s.i. pressure on the fresh-water system.



A TV set (by Ford!) entertained us at night when we were within range of a station. Next day the women made the beds while we rolled.

"You've got a foot at least," she said. Suddenly I had a thought. I pulled off onto the shoulder and readjusted the right and left outside rear-view mirrors to read the lane margins.

At the turnpike's end, the toll-booth attendant asked for \$3.50. The regular car toll is \$1.75.

"I'm a house car," I protested.

"You've got six wheels."

Throughout the trip we were to encounter a wide variation in charges on toll roads and bridges. Sometimes we were just a car, sometimes a truck, or possibly a bus.

Parking our house car. All the literature on the house car from Dodge and Frank Motor Homes, of Brown City, Mich., which builds it, had talked glowingly of parking anywhere at night.

Actually, we had five choices: roadside rest areas, trailer camps, private camp sites, and state and national parks. We preferred to avoid the somewhat cramped quarters of trailer camps.

The American Automobile Association, which had laid out our route meticulously on strip maps, had supplied us with a park directory. We had to drive 10 miles off our course to reach a Maryland state park that first night. The parking charge: a dollar.

"We're sloping," said my wife. "Better repark."

Both the bedroom and the stove did, indeed, have a list. After that we took care to select a level spot for the night.

The steak, I had to admit, was good. I switched on the generator and set up the TV. To even things out a bit with Ford Motor, which also sells a house car, I had borrowed a 16-inch portable manufactured by a Ford subsidiary, Philco. With only a rabbit-ear antenna, the picture was superb.

After three Westerns, my wife sighed. "This is just like at home," she said.

The bed was soft. Exhausted by anxiety and excitement, we slept a solid 10 hours.

Though we were up at 6:30, we didn't get under way for two hours. There are limitations to house-car travel. We had

to cook, eat, and do the dishes. It all took time.

At noon we had to halt to grocery-shop, eat, and do the dishes. At gas stops we had to replenish the kitchen water tank and, on the road, stop to drain the "holding tank" of used water.

By 4:30 we had to count our mileage and estimate the time to our night's bivouac. We had to arrive in daylight—we didn't want to grope around our parking place in the darkness. (Our mileage for each day proved to be about 200.)

We went the long way around Baltimore.

On the third day my wife announced, "The toilet's kaput."

In the hamlet of Granite Quarry, N. C., two resourceful workmen of the Gem Automatic Gas Co. fixed it.

Steadily, we crawled south. Temperatures soared. On the fifth day the air conditioner went out. On the sixth, we rolled into the one-time precincts of Jean Lafitte, buccaneer—New Orleans.

"Hi," Rosemary greeted my in-laws, the Homer T. Hoods. "Welcome to our perambulating pad."

Bag and baggage, the Hoods moved in. Homer, a retired engineer, has X-ray eyes for anything mechanical. If Esther, his wife, were a man, she would be high up in the diplomatic corps.

"How's it going?" asked Homer.

"Just dandy," I said, "with qualifications." I glanced at Rosemary.

She patted the dash. "With all thy faults," quoth she, "I love thee still."

The air conditioner turned out to have a broken freon line. We got it fixed. Now we headed north.

"Ride's good," remarked Homer. "Like my '54 Plymouth."

The standard fee on the Lake Pontchartrain bridge is \$1. Our tab: \$2.35.

We were still learning things about the Motor Home.

Item: Don't try to make ice cubes in the refrigerator while rolling—the water slops out.

Item: Refill the fresh-water tank at
[\[Continued on page 184\]](#)

These were the things that could stand some improvement



Emptying the used-water holding tank was sometimes a twice-a-day chore. Valve was unhandy, and whoever officiated got splashed.



Curtaining the window with snap fasteners for privacy at night could have been made easier with an aluminum I-beam and rollers.



Fresh-water tank often had to be filled twice a day because it held only 30 gallons. Six-gallon hot-water tank was also too small.

30,000 Miles Between

How safe is extended lubrication?

FOR three years now the battle has raged—in Detroit, in auto-agency service garages throughout the land, and in oil-company circles—about extended lubrication. The issue: Is that stretched, 30,000-mile lubrication period and its companion, the 4,000-to-6,000-mile oil change, a service to the motorist—or a danger?

On one side of the argument are the auto manufacturers' sales and advertising departments. On the other side are the engineers who design the vehicles, the auto agencies, commercial garages, filling stations, and the companies that produce the oil and grease.

The first side says "service," the second "danger."

The arguments of the auto makers' sales and advertising departments can be suspect. The claim that a car can run a long time, or distance, without attention is a first-class sales pitch.

The arguments of those who service cars and make the oil and grease can be suspect, too—the long-life lube and infrequent oil change cost them business.

The arguments of the engineers should have a ring of validity—this group has no axe to grind. So should the practices of fleet owners, who have no part in the argument at all.

Somewhere in the welter of disagreement should lie a nugget of truth. Who's right?

POPULAR SCIENCE decided to find out. First, we consulted the owner manuals. Ford Motor, American Motors, and Chrysler Corp. are pretty much all-out on extended maintenance. General Motors divisions are more conservative. Studebaker is the most conservative of all.

Some samples: Buick and Chevrolet, lube and change oil at each 6,000 miles;

Oldsmobile, lube at 30,000, change oil at 6,000; American Motors, 33,000 and 4,000; Ford, 36,000 and 6,000; Plymouth 32,000 and 4,000; Studebaker 1,000 and 4,000. All the companies add cautionary notes on more frequent oil changes under severe driving conditions.

Next, we went to the engineers, the servicing agencies, the American Petroleum Institute (the oil companies' trade association), and fleet operators for opinions. Detroit's sales and advertising departments had little to contribute. It was they who put the pressure on the engineers in the beginning for low maintenance as a sales incentive.

Interestingly enough, there was little basic disagreement on low-maintenance design. It's a good thing. Cars won't suffer from it. But the engineers attach a husky proviso: *given a certain set of conditions.*

GRADUALLY, a pattern developed in the complaints. These can be boiled down to two questions:

With infrequent lubing, what happens to the dozens of other items in a car that need frequent attention—and that *were* attended to in the day when a car was on the grease rack once a month? And, lulled by factory reassurances, don't most motorists fail to accommodate their servicing to the type of driving they do?

"When a manual says 30,000 miles between lubes, an owner tends to forget everything else on his car, even if he drives in dust so thick that he can't see his hand in front of his face," protested one engineer. "He just won't read the small print."

The rigid servicing requirements laid down by an East Coast fleet operator with 2,500 cars, and a West Coast company with 450 cars (quoted at right),

Grease Jobs

By Devon Francis PS Automobile Editor

probably provide the best answers to car care, with today's extended lube periods. Here are some of the East Coast company's servicing intervals:

- Each 2,000 miles—check automatic-transmission oil level, brake fluid, steering-box lubricant.
- 4,000—change engine oil and filter; clean or replace crankcase-ventilation valve; clean oil-filler vent and air cleaner; grease pedal joints, accelerator linkage, heat-riser valves, door locks; examine brake hoses and tubing, and steering connections.
- 5,000—rotate tires.
- 8,000—torque cylinder-head nuts; examine radiator and heater hoses.
- 10,000—lube speedometer and cable; check front-wheel alignment and front-wheel bearings.
- 15,000—adjust automatic-transmission bands.
- 20,000—lube universal joints.
- 30,000—replace shocks.

HERE are some of the servicing requirements of the West Coast fleet owner whose drivers stop-and-go all day:

- Each 1,500 miles—change engine oil and filter; clean oil-filler vent; lube throttle linkage, heat valves, door locks; check all belts for tension.
- 3,000—tune engine, check U-joints.
- 6,000—adjust automatic-transmission bands; check brake linings; lube U-joints; drain and repack differential; pack front-wheel bearings.
- Frequently—check body and door drain holes.

"You have to use your head on car care," commented this company's service manager. "We drained 28 pounds of water out of the body and door panels of one of our cars. Undercoating had sealed the holes."

What the Experts Say

A car dealer: "Sure, you can let your car go 30,000 miles between lubes, but you'd better take out a second mortgage on your house for repairs."

American Petroleum Institute: "There's no quarrel with long-life lubing. The new lubricants are built for it. But engine oil is something else again. The additives in it to prevent deposits, rust, and corrosion wear out. We recommend changing oil every 30 days in winter, every 60 in summer. It's cheaper to change oil than to change engines."

An East Coast fleet operator, with 2,500 cars rolling up 40,000,000 miles a year, trading his vehicles for new ones each 12 to 18 months: "The owner manuals specify lubing each 30,000 miles or so, but the factories pass the word along sometimes that oftener would be better. Where the manual says change the oil at 6,000, we change at 4,000."

A West Coast fleet operator, with 450 cars rolling up only 2,700,000 miles a year in stop-and-go driving, trading in each two years: "We go along on the recommended 30,000-mile lube, but we change the engine oil and filter every 90 days, or at 1,500 miles."

An engineer: "The biggest problem in running-gear wear is contamination of lubricants. Water carries the stuff in. Ball-joint seals are vulnerable to damage."

Another fleet owner: "We examined the ball joints on seven cars after 25,000 miles of extended maintenance. There were eight near-failures."

Another fleet owner: "Our sealed tie-rod ends showed defects in five percent of our cars after 25,000 miles."

An engineer: "Bear in mind that the extended lubing is only for the differential, tie-rod ends, idler arms, knuckle joints, and brake- and clutch-pedal bearings. There's a whale of a lot more than that to taking care of a car."

An engineer: "With sealed joints, you avoid having some grease monkey blow mud into them. But long lubes are good only if you take care of the rest of your machinery."

An engineer: "Extended lube is a mixed blessing. You don't get an examination of your undercarriage often enough. Do you want to entrust your life at high speeds to a piece of machinery that isn't serviced frequently?"

The news for '63: more and better machines, easy-start engines

New Snow Throwers Blow Away the Work



By Harry Walton

THIS winter of '63 may go down as the one in which snow throwers came to stay. Not so long ago, the owner of a motorized snow remover was a rare sight—and not always the envy of his neighbors. For many of the early machines were hastily cobbled-up contraptions that whirred and clattered but often didn't really move much snow.

Today's snow throwers show a highly advanced mechanical art—a typical 4-hp. machine, for instance, can move 750 pounds of snow a minute, a staggering $22\frac{1}{2}$ tons an hour. So efficient have such machines become that makers are booming them as a basic yard tool—just as necessary as the now commonplace power mower.

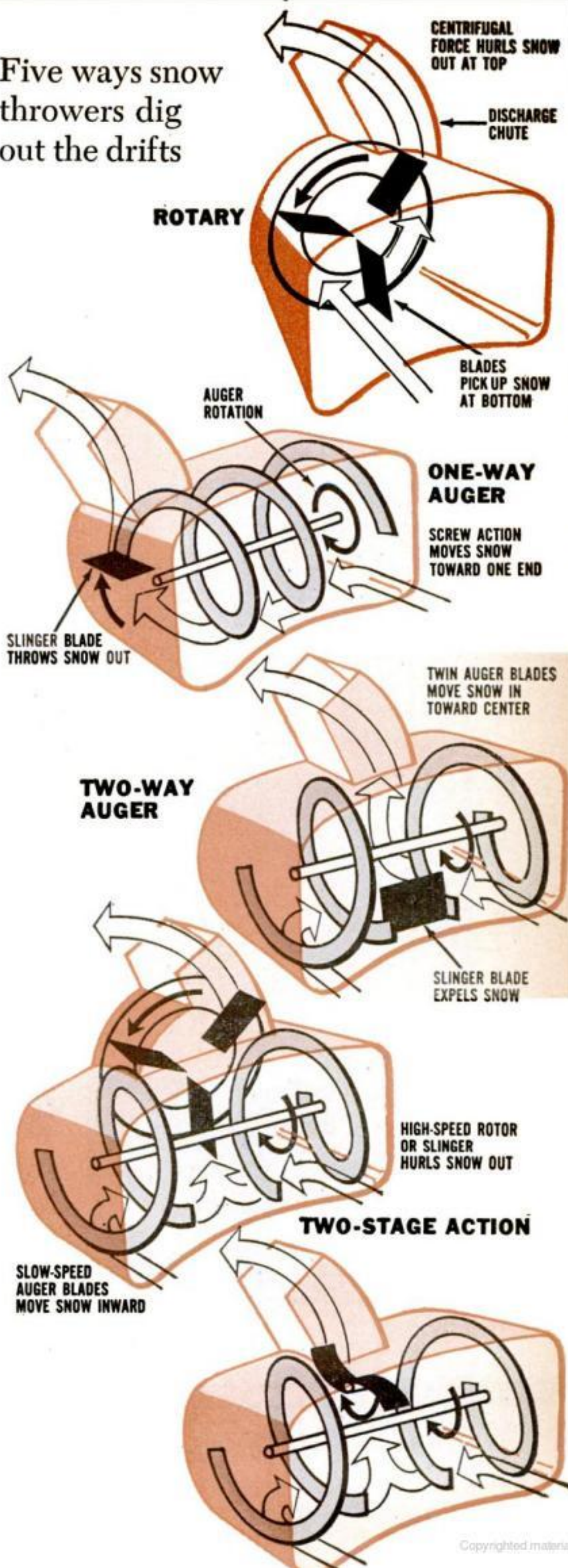
To bring this about, manufacturers have had to wriggle out of some curious mechanical dilemmas. For a decade, they devoted all their engineering efforts to producing mower engines that ran cool. Suddenly they had to turn around and do just the opposite—develop engines that stay warm in freezing weather. The result is a brand-new breed of specially winterized power plants.

Still another paradox: Snow throwers need low speed and high torque to chop out heavy, hard-packed, often frozen snow. But they need high speed to sling the snow up and out and away from the machine. How to provide both at the same time has been a major engineering problem. That the makers still don't agree on just how best to solve the problem is evident in the fact that you find four different kinds of snow-moving mechanisms in the current line-up:

- Rotaries, like big highway and railway snow plows, with blades on one face of a rotating disk.

- One-way augers (similar to worms in some conveyor systems)

Five ways snow throwers dig out the drifts

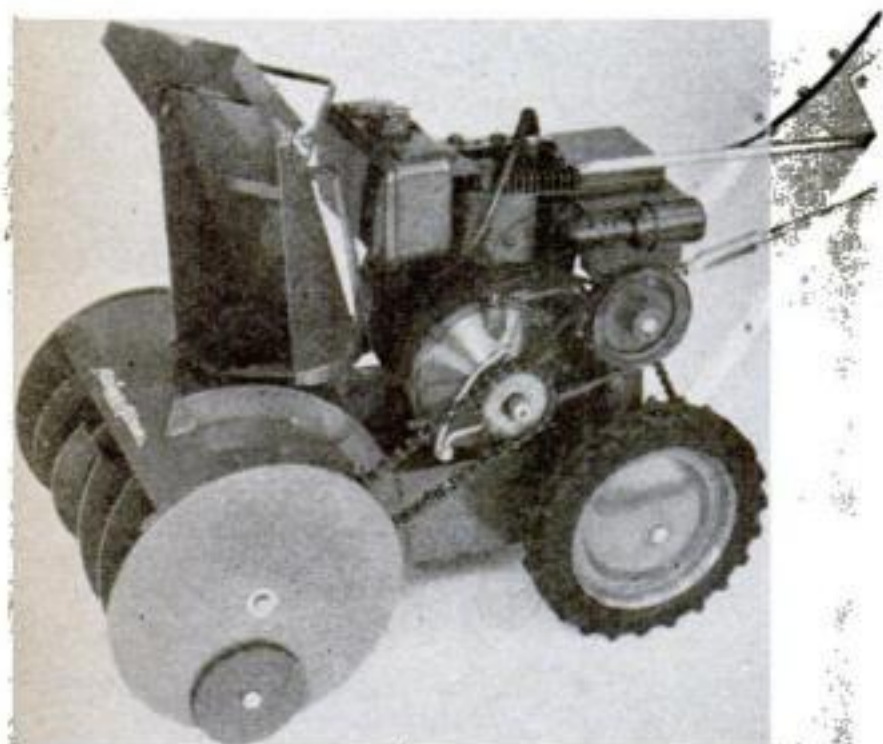


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Gas engines and electric motors ease the labor of removing snow



It works, you ride: Tractors with snow-thruster attachments are the plushiest. This 7-hp. Jacobsen clears 36-inch swath. Discharge direction can be changed from the driver's seat.



Self-propelled Atlas-Aire machine has a geared output shaft on the engine and a V-belt wheel clutch. The exposed chains are easy to service, but more hazardous than enclosed ones.



Plug in to start: A new starter kit for 4½- to 6-hp. Lauson engines rectifies house current. User plugs in a cord to energize the starter, disconnects it when engine catches.

All-electric Sunbeam at right, new this season, is light enough to hang on a wall. Its 1¼-hp., 8-amp motor is said by its makers to have greater stall torque than a 3½-hp. gas engine.

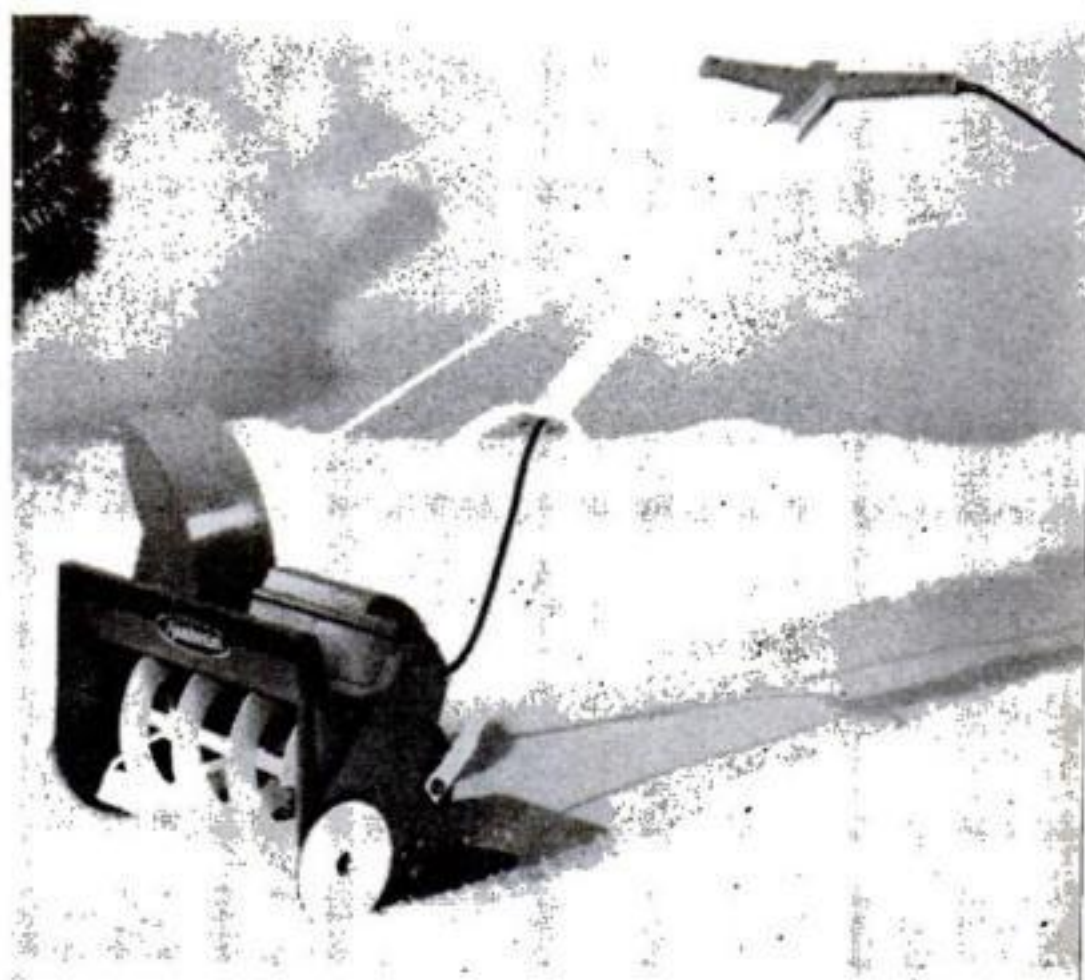
that feed snow toward one end, into flat blades that sling it out.

- Two-way augers with right-hand and left-hand helix on the same shaft. Both carry snow from the ends toward the middle, where slinger blades hurl it out.

- Two-stage machines with a two-way auger to deliver snow to a second mechanism, which discharges it. In some, this is a rotary unit. In others, there are slinger blades on a separate shaft that turns faster than the auger.

Which is best? A lot depends on where you live, how cold it gets, and whether your snowfalls are generally light or heavy. Given equal power, two-way augers may find the going a bit easier in deep stuff than the one-way types because their divided blade needs to move snow only half as far. Two-stage machines, especially those that provide separate speeds for scooping and slinging, can usually be expected to outperform the simpler single-stagers. Against their greater efficiency is a higher price tag and somewhat more complicated maintenance.

If your yard is big or hilly, you'll welcome a self-propelled machine that does the pushing for you. The hand-pushed



type is cheaper, but is probably a good buy only in light-snow areas.

On the self-propelleds, you're paying for more horsepower and a separate wheel drive that has its own controls, ranging from one speed forward to four forward plus reverse. The simplest drive—two fixed wheels on a powered axle—will give you some back talk on turns because the wheels aren't permitted to spin at different speeds. Deluxe machines have a real car-type differential. Others use ratchets that let the outer wheel overrun the inner one to avoid bucking.

What happens if a rock wedges in the auger? Centrifugal clutches and belt drives slip. One machine has a spring-loaded ratchet clutch whose teeth ride up and ratchet past each other in case of a sudden heavy overload. Others have replaceable shear pins.

Those sub-zero engines. On older one-lungers, snow first melted and then froze overnight, fouling ignition parts, carburetor linkage, governors, and recoil starters. Plugging gas-cap vents, it caused mysterious fuel failures.

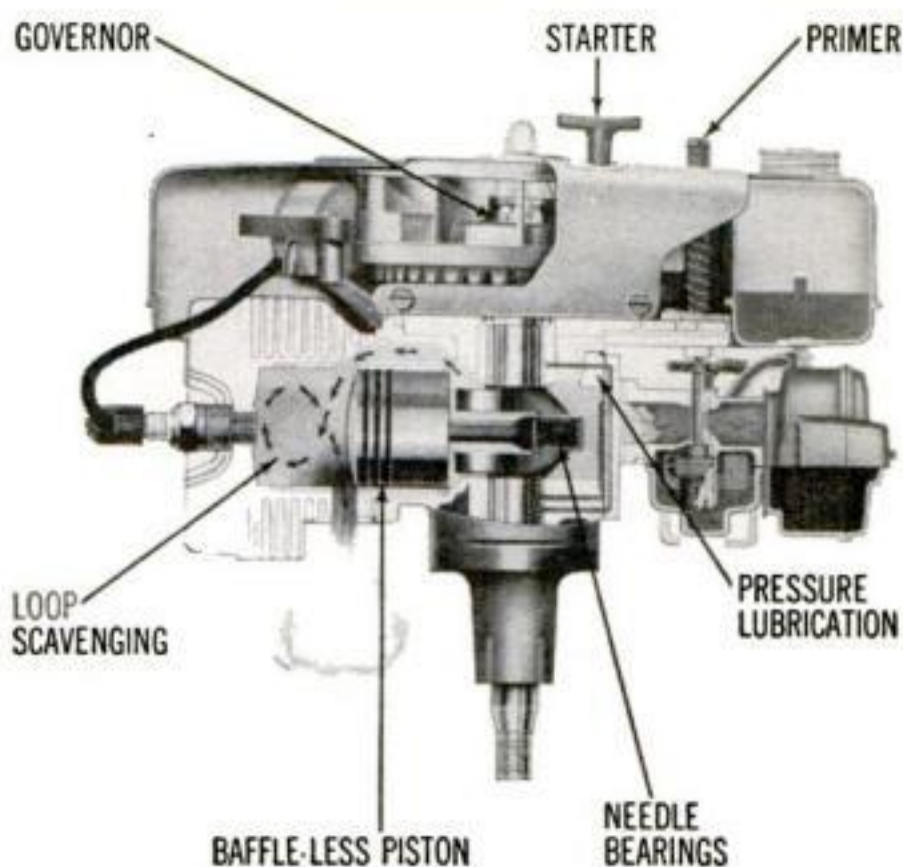
Today, makers lick the problem by keeping snow out as much as possible, and by evaporating moisture with engine heat. Shrouds and baffles divert heat over potential freeze points. Starters are redesigned to lock out moisture. Some tank caps have as many as four vents to thwart ice blockage.

A saucy two-cycler, made by Outboard Marine to power its Lawn-Boy, has no crankcase oil to congeal in zero weather (as in outboards, oil is mixed with the gas). A tube routes engine heat to warm the intake air and keep ice off the auger drive chain.

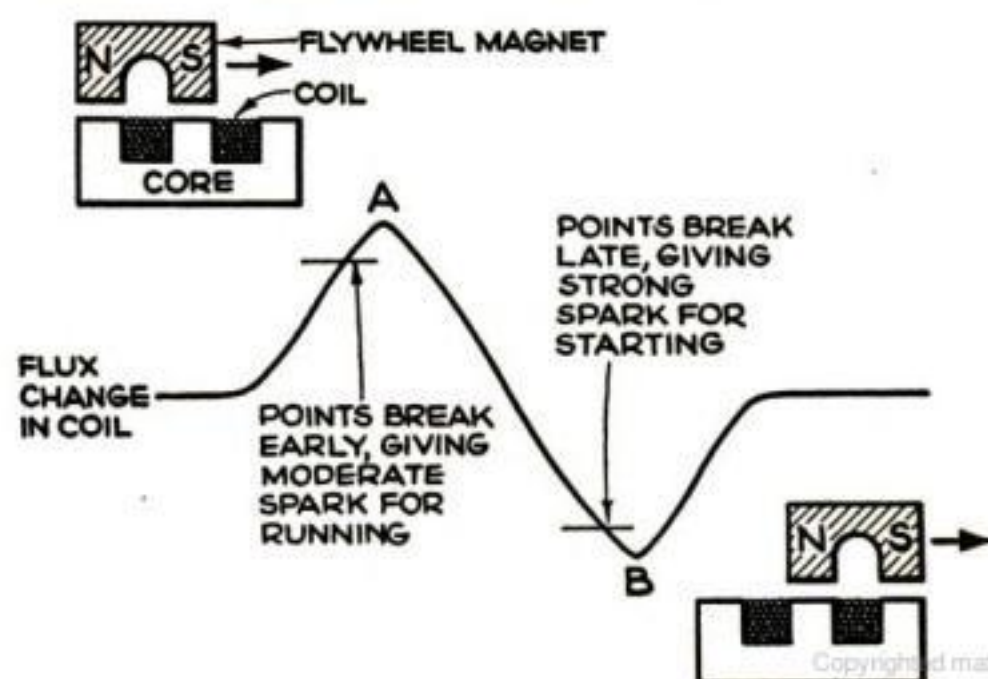
An extra-strong starting spark and a primer instead of a choke, says OMC, make this machine easy to start at way below zero. Also unusual is loop scavenging, which does away with the piston baffle—focal point for carbon accumulations and other grief. The intake directs the fuel charge up over the piston so it loops around, chasing the last traces of the exhaust before it.



Primer pump replaces conventional choke on Outboard Marine's Lawn-Boy snow blower. Running at 4,000 r.p.m., the 3½-hp. engine spins a 15-inch auger. A crank and gear allow the user to rotate discharge chute while working.



New twin-spark ignition uses conventional three-legged coil core and two-pole magnet. As magnet crosses the first two core legs (A, below) it creates a moderate flux change. But in passing to position B it creates a far greater flux change, when the piston is over dead center and cannot kick back. In the OMC engine, the points first open at B, giving a very hot spark for starting. At 1,000 r.p.m. a snap-action cam shifts point opening to A for a weaker but advanced running spark.





Here's country-club styling, automatic shift, and a four-wheel drive

Jeep Wagoneer: It Looks Pretty, Acts Tough

By Alex Markovich

Car creeps up 60-percent slope with engine running at barely over idle speed. It's in low range and four-wheel drive.

WHEN you see the new Jeep Wagoneer for the first time, you're in for a batch of surprises. The first is that it's stylish enough to impress the Joneses.

Doors open unusually wide—nearly 90 degrees. The bench seats are comfortable. Instruments are well placed.

Surprise number two is the car's performance on rough terrain. Four-wheel drive is optional with the manual transmission and—for the first time ever—with an automatic. It's controlled by a single floor lever. On the manual-shift model, this lever also allows shifting into low range, giving six forward and two reverse gears.

The husky overhead-cam engine gives the car the climbing ability of a monkey on a pep-pill diet. But since the suspension is a compromise for both high-

way and off-the-road driving, a little caution is necessary on unfamiliar terrain.

How does it handle on the road? Like a passenger car. That's surprise number three. The Wagoneer has a big-car feel. But with the reasonably fast power steering ($4\frac{1}{4}$ turns lock-to-lock), maneuvering in traffic is no problem. On the open road in a stiff cross wind, the car is remarkably stable for a wagon. The ride is no firmer than that of many conventional wagons. There's no drive-train whine. Brakes are adequate.

The Borg-Warner three-speed torque-converter automatic shifts crisply. But for heavy-duty work with four-wheel drive, the manual box is better; its low range is lower than the automatic's.

Under full throttle, the automatic gearbox on our test car shifted at about 18 and 50 m.p.h. It may, however, be



Accurate m.p.g. tests were made with burette. The wooden box on the seat is a speedometer hooked up to a trailing fifth wheel.



There's lots of hauling space, especially when the rear seat is collapsed. Tailgate opening is larger than that of any other wagon.



Independent torsion-bar front suspension is optional with four-wheel drive. Advantages include soft ride, better off-road traction.



Single floor lever engages four-wheel drive and shifts into neutral for power take-off. Shifts can be made even at high speed.

reworked to shift at 30 and 60 by the time you read this.

To whom will the Wagoneer appeal? Almost anyone. It's as much at home in front of a country club as on a moun-

tain trail. Its price is attractive, too. The two-wheel-drive wagon starts at \$2,344. With four-wheel drive, it's \$3,025. But whoever buys 'em, one thing's certain: They'll be bought.

FACTS ON THE JEEP WAGONEER

Model: four-door station wagon.

Engine: overhead-cam in-line six; 140 hp. at 4,000 r.p.m.; maximum torque, 210 pounds-feet at 1,750 r.p.m.; compression ratio, 8.5:1; bore and stroke, 3.34 by 4.38 in.; displacement, 230 cu. in.

Curb weight: 3,668 pounds.

Transmission: three-speed.

Steering: 4.25 turns lock-to-lock (power).

Effective brake-lining area: 161.16 sq. in.

Outside dimensions: wheelbase, 110 in.; overall length, 183.6 in.

Tire size: 7.10 by 15.

Speedometer error:

<i>Indicated m.p.h.</i>	<i>Actual m.p.h.</i>
40	37
50	46
60	55
70	64

Gas mileage at constant speeds:

30 m.p.h.	19.51
40 m.p.h.	18.12
50 m.p.h.	16.97
60 m.p.h.	15.45

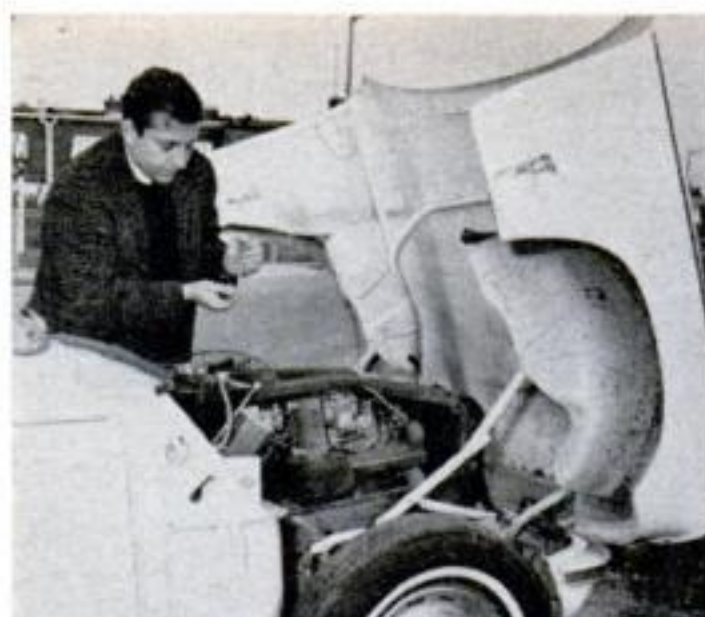
Gas mileage, stop-and-go driving: 13 (est.).

Acceleration:

0-60 m.p.h.	15.0 seconds
40-60 m.p.h.	8.1 seconds
50-70 m.p.h.	11.5 seconds
Top speed:	92 m.p.h. (estimated).



Quad lights, new grille mark Sports Six. Top goes up and down faster than you can say "God Save the Queen."



Entire front end opens wide and says *aah*, showing engine and suspension.

REPORT FROM THE DRIVER'S SEAT

Triumph Six: Family Sports Car

IT LOOKS like any of several foreign subcompacts—crisp, straight lines, kiddy-wagon wheelbase. Outwardly it's just a Triumph 1200 (Herald) with slightly different trim. True, a 97.39-inch six (a Vanguard with smaller bore) lurks under the bonnet. But that \$2,500 price tag, I thought, went beyond the bounds of propriety.

I began to change my mind when I opened the door. The interior is plush: walnut-paneled window moldings and dash; pleated upholstery.

Front seats are adjustable for rake. They're comfortable for the tallest driver. But rear-seat leg room is adequate only if you're built like Humpty Dumpty.

The little six is far more lovable than the old four. It's smooth and peppy. The gearshift is a thing of beauty: precise, short throw. Exceptionally well-synched. The disk-drum brakes, too, leave nothing to be desired.

Handling is tops. Steering is fast and sensitive, and provides a 25-foot turning circle. The car goes where it's pointed until near the limit of adhesion. The tail finally does break loose, but with plenty of warning. Even an awkward driver can set things straight. Hardly any body roll.

My only gripe: a milquetoast horn.

When you come to think of it, 2½ Gs isn't so much for an honest-to-goodness family sports car.—*Alex Markovich*.

FACTS ON THE TRIUMPH SPORTS SIX

Model: four-passenger convertible.

Engine: overhead-valve in-line six; 70 hp. at 5,000 r.p.m.; maximum torque, 92.5 pounds-feet at 2,800 r.p.m.; compression ratio, 8.45:1; bore and stroke, 2.628 by 2.992 in.; displacement, 97.39 cu. in.

Curb weight: 2,044 pounds.

Transmission: four-speed.

Steering: 3¾ turns lock-to-lock.

Effective brake-lining area: 144 sq. in.

Outside dimensions: wheelbase, 91.5 in.; overall length, 153 in.

Tire size: 5.60 by 13 (nylon tubeless).

Speedometer error:

<i>Indicated m.p.h.</i>	<i>Actual m.p.h.</i>
40	36
50	45.5
60	54.5
70	64

Gas mileage at constant speeds:

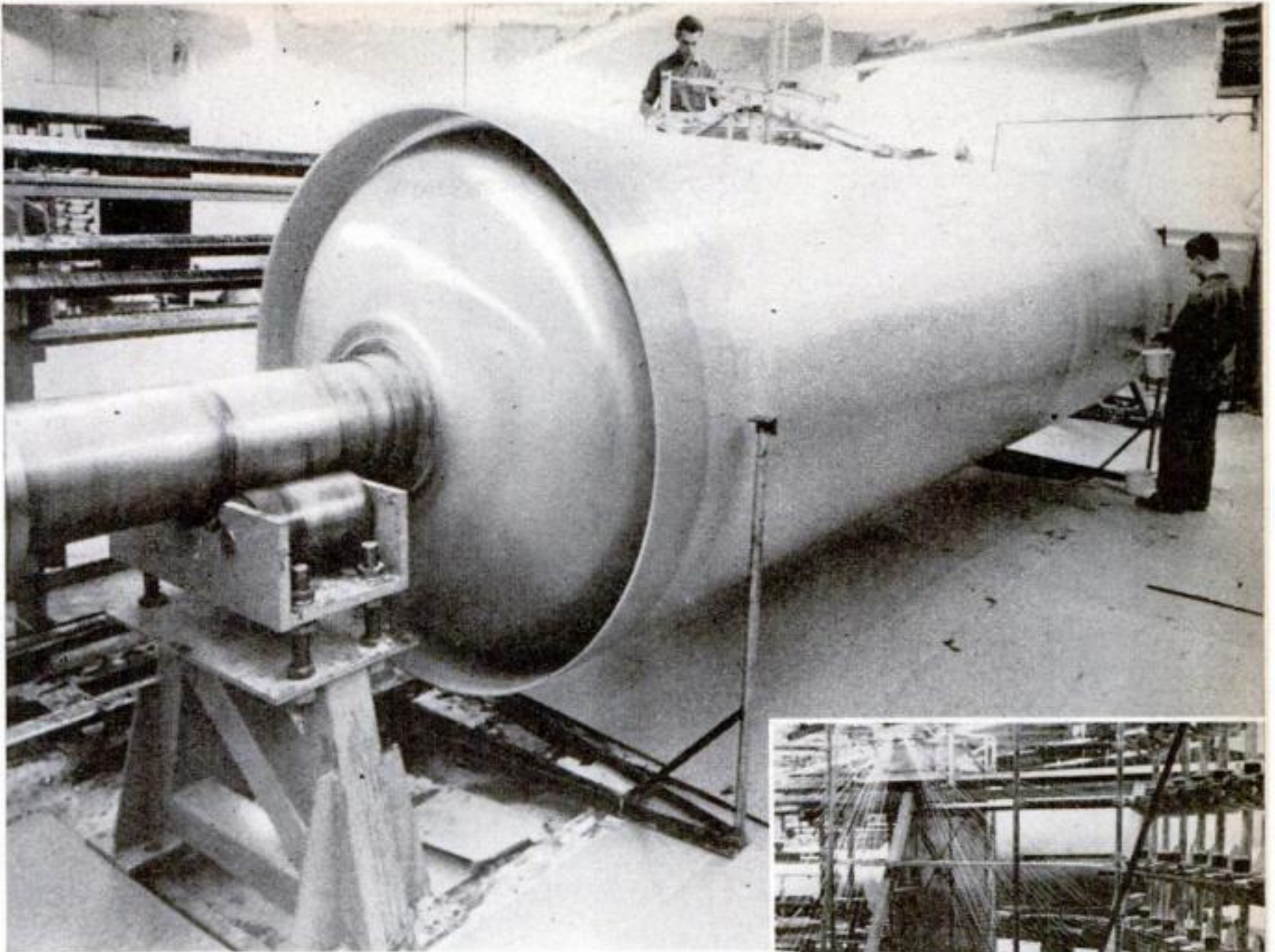
30 m.p.h.	32.86
40 m.p.h.	31.62
50 m.p.h.	29.50
60 m.p.h.	27.01

Gas mileage, stop-and-go driving: 23.40

Acceleration:

0-60 m.p.h.	15.6 seconds
40-60 m.p.h.	7.5 seconds
50-70 m.p.h.	9.4 seconds

Top speed: 92 m.p.h. (estimated).



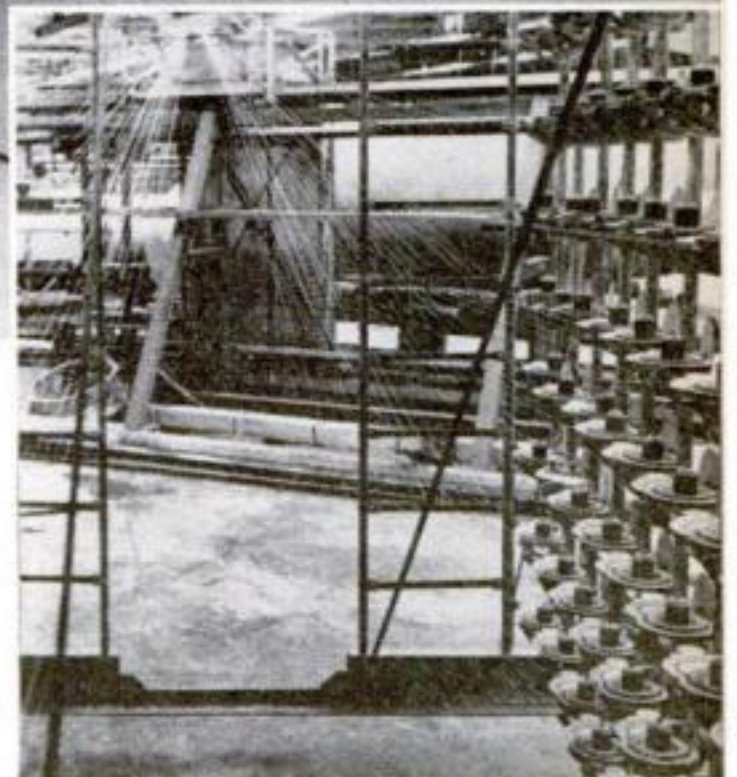
Winding machine with arm extended above cylinder lays glass filaments on spinning plaster mandrel. Helper on floor at right squeegees excess epoxy into bucket.

Fiber-glass rocket case for big missiles

Rocket-engine casings for some of our big solid-propellant missiles are now being made of fiber-glass instead of steel. They are stronger and lighter than steel, and require no insulation liner since fiber-glass itself is a heat insulator.

The engine case shown here in production was wound at the Lamtex Industries plant in Farmingdale, N.Y., and stood up under exhaustive testing for the Air Force by Thiokol Chemical Corp. Lamtex had to design a special automatic machine to wind the 22-foot-long, 5½-foot-diameter casing (Minuteman size). The new winder gathers thousands of glass filaments from banks of creels, draws them through a bonding bath of epoxy resin, and winds them continuously on a plaster mandrel spinning on an axle like a giant lathe.

The machine runs up and down a track, building the casing in layers to a thickness of .355 inch and using a total of 2.7 million miles of filament while doing it. After the epoxy has hardened, a technician crawls through an exhaust port to break the plaster out with a hammer.



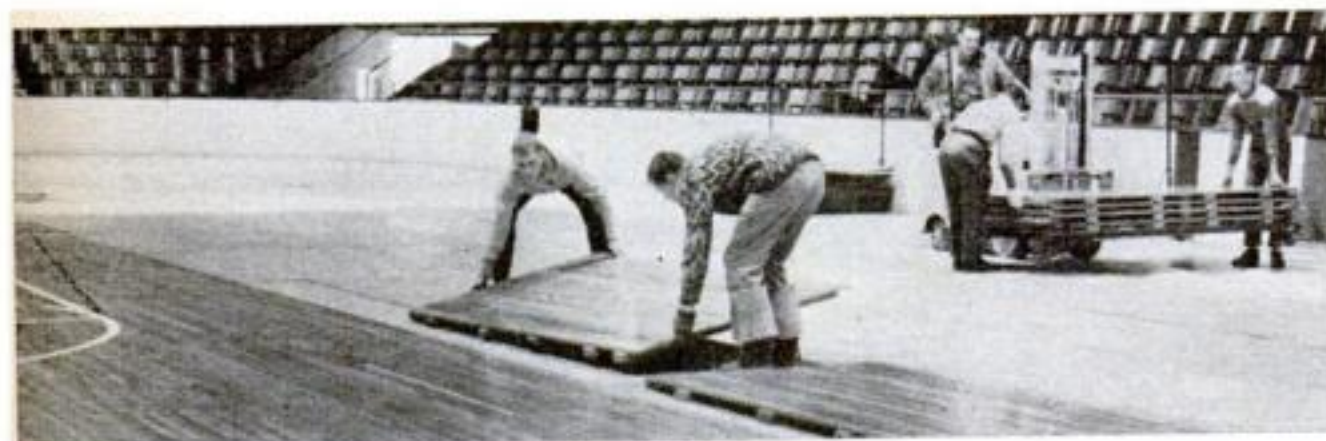
Millions of miles of filaments are taken from banks of creels, passing through epoxy resin bath to winding machine above cylinder in background.



Plaster mandrel is broken out by hand after work is done. Technician with hammer has to be pretty thin to fit through exhaust port in end.



Skaters glide on rink in afternoon . . .



. . . then new floor is laid over ice . . .



. . . and cagers take over at night.

Hot game of basketball played on ice

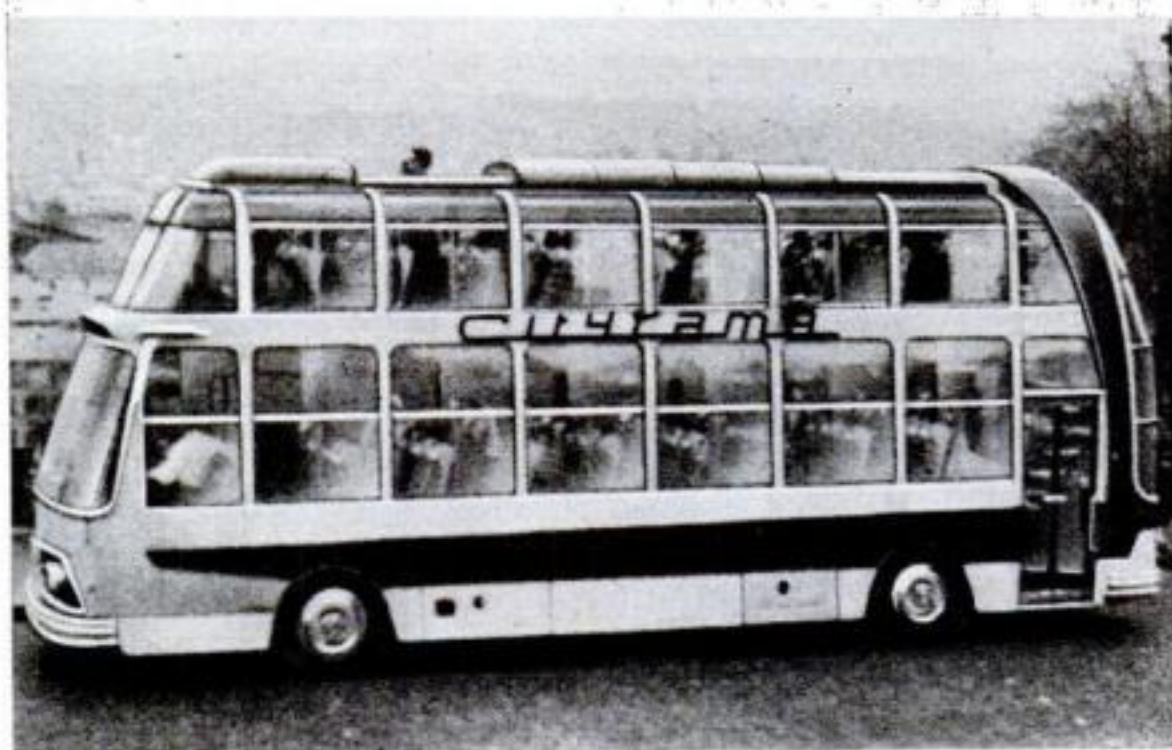
When the Camden Bullets of the Eastern Basketball League were looking for a home court, a skating rink in nearby Haddonfield, N.J., came up with a quick solution. At the Delaware Valley Garden, panels of urethane-foam insulation were laid over polyethylene sheeting, then covered with tempered hardboard, finally topped with four-by-eight-foot basketball floor sections.

The conversion takes less than five hours. The result: skating every afternoon, basketball and other events at night with no lost time for thawing and refreezing.

Double-deck bubble bus

Unusual sight in Paris is this double-deck bus for sightseers. Its glass-windowed, bubble-shaped body has wraparound windshields top and bottom with no posts to obstruct view. The roof has sliding sections so tourists can stand up for a windowless look if they wish.

The vehicle, called a Cityrama, carries 68 passengers in aircraft-type seats, has separate doors for upper and lower decks on its overhanging tail platform.





Back to the days of coal burners

Newest locomotive on the Union Pacific burns—guess what—coal. But unlike the traditional steam engine of yesterday, it's a coal-burning turbine-electric. The ex-

perimental engine is made up of a diesel unit for movement through yards, a coal-burning middle containing turbines and generating equipment, and a tender for carrying and pulverizing coal. If it proves a success, the diesel part will be eliminated.



Towing a refinery 3,000 miles

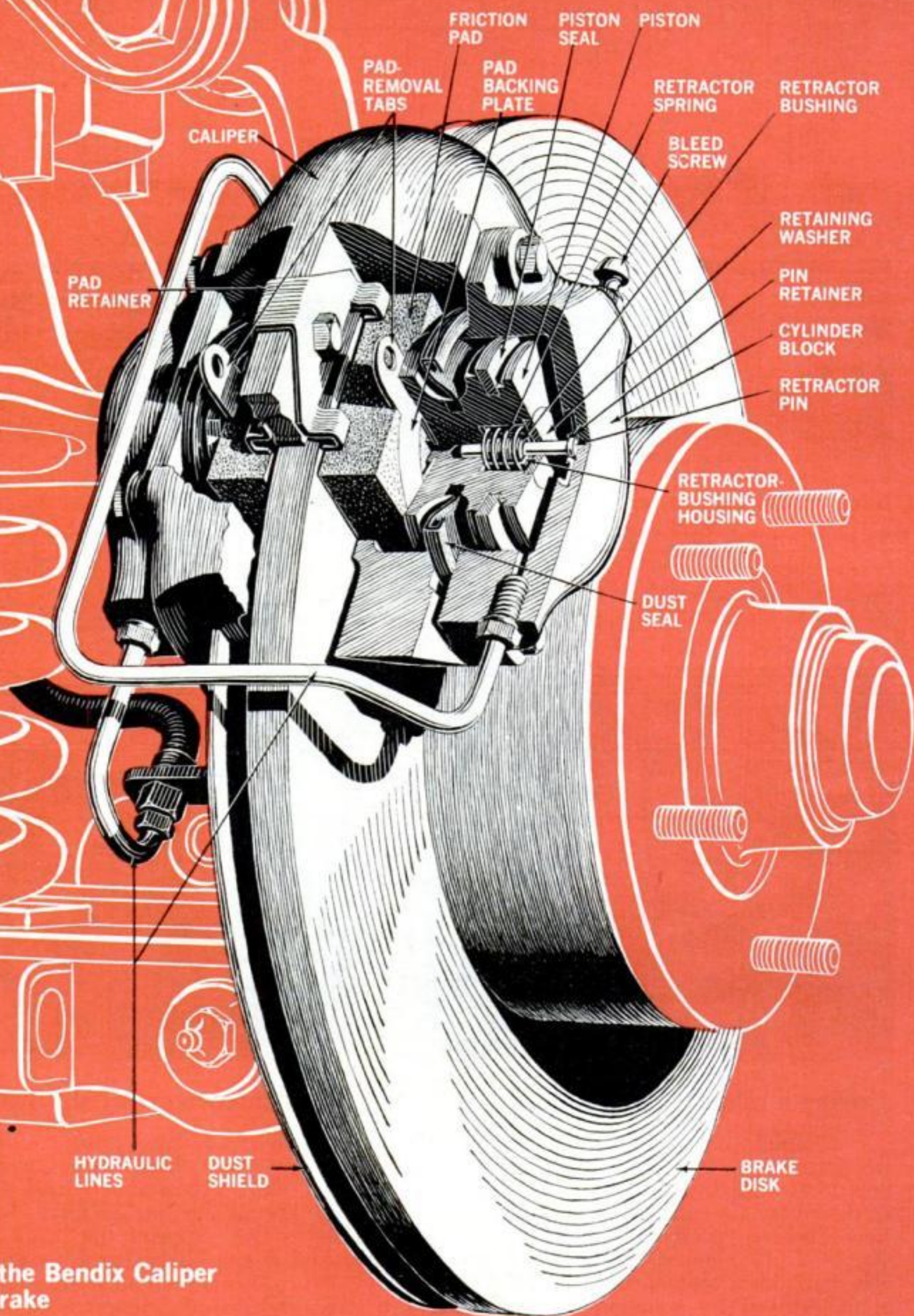
A complete oil refinery, built on a concrete barge, has been towed 3,000 miles by tugs to the Mediterranean coast of Africa. Designed by Chemical Construction Co. of New York to specifications by Esso for a Standard Oil affiliate in Libya, the plant was built at a shipyard in Antwerp, Belgium. Towed by seagoing tugs to North Africa, it was floated into a canal dug at Port Brega, on the Libyan coast. When the canal was drained, the barge became the oil plant's foundation.

By summer the refinery, tapping an oil field 100 miles inland, will be producing kerosene, gasoline, diesel oil, and fuel oil at a rate of 8,000 barrels a day.



Detroit influence on sedate Britisher

Rolls-Royce for 1963 bows to the four-eyed trend, but clings to its classic radiator grille. The stainless-steel front is slightly shrunk to make room for dual headlights and to lower the hood line for improved vision. Undisclosed horsepower of the 380-cu.-in. aluminum V-8 is up seven percent by raising compression ratio to 9:1 and using larger carburetors with a modified induction system. Refinements include a headlight flasher, map-reading light, and added radio speaker in the rear. Four-speed automatic transmission, power steering, and mechanically assisted brakes with separate hydraulic circuits for front and rear wheels are standard.



Inside the Bendix Caliper Disk Brake

Typical of current disk design is this brake, used on Studebaker front wheels this year. Brake disk is attached to wheel and is gripped, as in a vise, by a caliper anchored to knuckle of front-wheel spindle. Friction pads contact only a small fraction of total periphery of disk. Remainder of disk is exposed to air. Brake is self-adjusting for

pad wear: Inside the piston a retractor bushing grips the retractor pin firmly, advancing a minute distance toward disk on brake application, and holding there—as piston forces pad against disk. Piston return travel, on brake release, is limited each time by new position of retractor bushing, which sets "home base" for piston.

People who know cars are asking Detroit:

What's Holding Up Disk Brakes?

By Hubert Lockett

COULD you stop more quickly and safely if your car had disk brakes? Would you more surely avoid an accident in a crisis? Yes, say many knowledgeable car enthusiasts who follow sports-car and Grand Prix racing closely—and now, increasingly, are clamoring for disk brakes on their personal cars.

An impressive record has been stacked up; it's getting to where you just can't win a road race without disks. Eighty-five percent of the sports-car models and 65 percent of the big-engined passenger-car models produced in Great Britain last year had disk brakes. On the Continent, several models have had them for years, and many more have just now come out with disks as standard equipment.

What's holding up disks on American cars? Is Detroit stalling off the adoption because of their heavy investment in tooling for drum brakes, or because they think their customers won't pay the extra cost—or have they been caught napping on engineering development?

An independent, Studebaker, broke the ice this year with disks in front on their hot new Avanti, and as extra-cost options on their standard passenger cars. Will this force the Big Three to follow?

You can get yes, no, and maybe answers to all these questions from equally qualified insiders in the car business. The arguments, both for and against disk brakes, have become clouded with half-truths. To anticipate one conclusion to be made in this article, you may be a lot better off than you realize with your present drum brakes.

And another thought: With disks, you might be paying for more brakes than you will use.

To clear up some of the mistaken notions, you need to start with a few fundamental facts:

Heat engines. Your car's engine converts the heat from burning fuel into mechanical energy to make the car go. Brakes are heat engines, too—but the process is reversed. To stop your car, they convert the mechanical energy of motion into heat. Although it may seem illogical, one way of looking at brakes is as heat generators. Theoretically, the faster they can generate heat, the quicker they'll stop your car. It's friction, of course, that produces the heat. The rate of heat production is determined by the rubbing speed, the force pressing the friction material against the drum or disk, and the coefficient of friction for the materials.

The last of these is the most troublesome to cope with in practical brake systems. Lining friction changes with variations in a whole handful of factors, unavoidably present in normal brake operation. The main one is temperature. When currently used organic linings get hot, the coefficient of friction drops. At some high temperature it drops so low that the linings act almost as though they were greased. This is what happens when you get severe brake fade. There is a basic conflict: Brakes must generate heat, but if they get too hot, they won't work.

You can tackle the problem from different angles:

- Some linings fade at lower temperatures than others—you can try to find

lining materials that retain effectiveness at high temperatures.

- Brake types vary considerably in their ability to tolerate changes in lining friction. Disks are more tolerant in this respect than present drum brakes.

- Cooling the brake more effectively will allow outflow of heat to balance the inflow at a lower temperature so that more heat can be generated without exceeding the fade temperature of the lining.

A quick review of the virtues of disks explains why many experts want to give up on drums and switch to disks:

- Brake fade (the temporary loss of brake effectiveness due to heat) under punishing use is less than with drums.

- Consistency and stability are substantially better under all conditions.

- Worn friction pads can be quickly and cheaply replaced.

- Disk brakes can easily be made self-adjusting (see drawing).

- Wetting has relatively little effect on performance.

- Unsprung weight is reduced.

It seems a little like being against home and mother when U.S. brake engineers will concede these facts but refuse to press for the adoption of disks on American cars. As one brake engineer told me: "If we go to disks it will be because of pressure from the sales department—not for any sound engineering reason."

Behind this attitude are several assumptions about you as a driver and the kind of driving you do:

- You demand light brake-pedal pressure, low pedal height, and short pedal travel.

- With the kind of driving you do, you never exceed the capacity of drum brakes to stop your car.

- You are satisfied with the brake performance on late-model cars and would balk at paying extra for disks.

The hard core of opposition to disks centers around that first item. Current drum brakes are highly self-energizing. The bulk of the energy required to apply the brakes is borrowed from the

forward motion of the car. When you step on the pedal and force the shoes lightly against the drum, a wedging or wrapping action of the primary shoe develops a powerful force that is transmitted through a linkage to the secondary shoe. About 80 percent of the total braking effort is furnished by the secondary shoe.

But disks require effort. Your leg has to exert all the force required. To give you an idea of what this means, suppose the required braking effort on a wheel is 8,000 in.-lbs. torque. By actual test, using an 11-inch drum on a popular make car, the input force to the shoe is 280 pounds. A disk brake that could fit in the same space would have an effective diameter of 8½ inches. The input force to produce the same torque is 2,000 pounds. If you had to push with a 50-pound effort with the drum, you'd need a 3,500-pound push with a disk using the same overall linkage ratio. Or you'd need seven times as much pedal travel.

The second point is based on the reasonable assumption that there is nothing gained by providing braking capacity you don't use. This has nothing to do with how quickly you can stop in any one instance. (Tests have shown that drum brakes can stop you as quickly as disks at speeds up to 100 m.p.h.) With any modern brakes, your car's stopping ability is limited by the frictional reaction between the tires and road surface—not by inadequate braking force. The capacity of the brake refers to total amount of braking you can do before you allow the brakes time to cool.

A good drum brake can easily toss off a dozen or more panic stops from 80 m.p.h. in rapid succession without significant fade. A recent test with disks ran 30 such stops, and gave up. No evidence of appreciable fade showed up.

But on the long straight highways in the U.S., who needs to make a dozen panic stops in the space of a few minutes? Of course it's a different story in a road race or on Europe's winding roads, where disks have earned their fame.

[Continued on page 197]

Should You Tell on the Other Driver?

It's a tough problem—and it arises when you least expect it. To take you off the spot, here are common-sense pointers gathered from the police

By E. D. Fales Jr.

ON A cross-country trip the other day two tourists in a green Ford saw a car weaving wildly. The passenger in the Ford said: "We're coming to a tollgate. You'd better report him."

The driver said: "No. I'm no busybody."

"He may kill somebody."

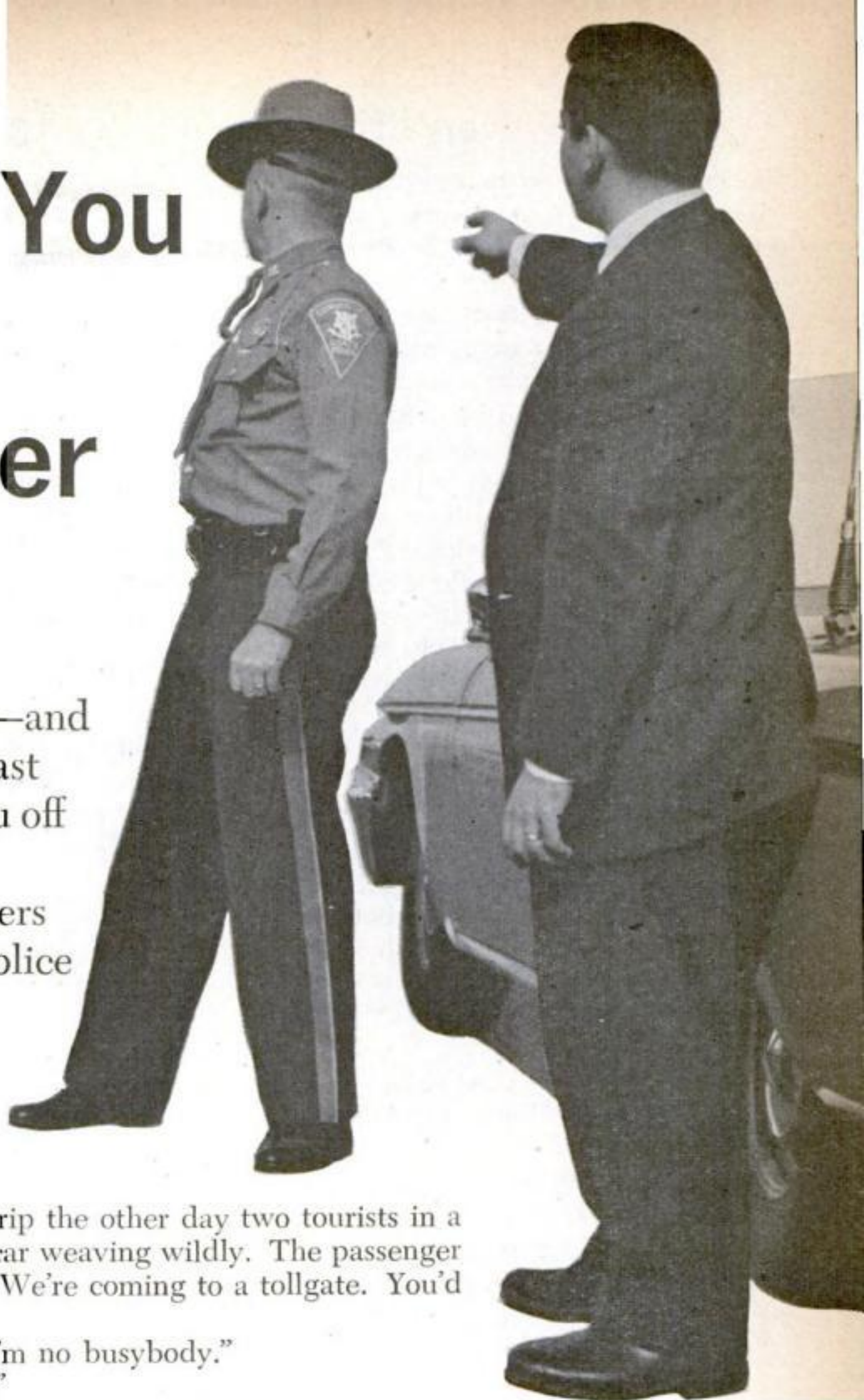
"Well, that's for the police to worry about."

Who was right—driver or passenger?

In a small Midwest town, a New York car went through a red light. Two local motorists saw it. One said: "I'm going to tell a cop." The other said: "That's a mean trick. Anyway, the cop will just think you're a trouble-maker."

Who's right in such cases—and others that every motorist sees at times? Should you—or shouldn't you—tell? The question is becoming more important today for two reasons.

First, accidents are getting worse. A bad driver used to kill one or two people. Now he often kills six or seven. A lot of drivers are getting red hot about bad driving. If you don't think so, then you should know that an Eastern newspaper



Every driver now and then gets sore when another

recently suggested that vigilantes take to the roads to spy out drivers who do things wrong, then send their license numbers to police.

No driver likes to think of stirring up trouble for others or of playing amateur cop; yet every driver sees things at times that he feels should be "reported." And let's face it: Every driver now and then gets sore at somebody who cut him off, or otherwise offended him, and he'd like to see the offender bawled out or pinched. Does this mean he should run to the cops?

I put the question to state police in Connecticut and Pennsylvania. I knew I'd get good answers because while Connecticut's troopers are strict, they also lean over backward to be fair. And Pennsylvania's troopers operate under a "do-as-you'd-be-done-by" rule laid down by their commander, Col. Frank McCartney.

Here are some pointers I gathered that will help you draw the line between fair, useful citizenship and foolish tattling:

*What the toll-road riders
should have done*

The passenger was right, says Connecticut's Lieut. Walter Stecko. The driver was mistaken: In trying to be fair to the careless driver, he was *unfair to careful drivers* who, for many miles ahead, would be endangered.

Pennsylvania's Sgt. Joseph Tappe gave this example to clinch the point:

The "weaver" on U.S. 30

Near York, Pa., a salesman watched a car ahead of his weaving from side to side and thought: "I should phone the police." But the old phrase, "It's none of my business," leaped to mind.

He delayed acting. After a few miles he saw the car swerve violently, then start speeding. Alarmed now, the salesman, in a burst of speed, got ahead and roared into Stone Bridge, Pa.

Here he saw Sergeant Tappe parked by the road. He shouted to Tappe: "There's a guy behind me driving all over the road. You'd better stop him *quick*."

Then the salesman drove on, wondering if he'd been fair to another driver who'd had a couple of drinks too many.

Seconds later, the weaver roared over a hill into Tappe's vision. Sure enough, he was coming on the wrong side of the road.

"His speed was close to 70," Tappe says. "I jumped out to wave him down." He came right for Tappe. Tappe jumped aside, sprinted to his patrol car. The weaver started up and over a bridge, still on the wrong side.

Coming up the other side of the bridge was a car occupied by a young couple.

"I'll never forget that crash," Tappe says. "Those two cars hit head-on, went right up in the air and came down in pieces. When they came down the 'weaver' was dead and the two innocent people were lying in the road critically hurt.

"Every trooper thinks of cases like this," says Tappe, "when some driver fails to report a wild car. If we'd had an earlier report we could have closed the road and nabbed the driver. Was it fair to let him do what he did—and to kill himself?"

The case of the red light runner

But how about the out-of-state driver who ran through a red light? Who was right—the man who wanted to turn him in, or the one who demurred?

Police say: That depends on what happens next.

Tourists often fail to see traffic lights in strange towns. To report such an error is, of course, nonsense. This is one that should be left to the police.

But...

"If the car then tears through town recklessly," says Lieutenant Stecko, "lives are in danger and it should be reported at once." Such a driver could be drunk, racing, dangerously angry—or escaping from a crime. Police should know.

The car that cuts you off

You're on a busy street. Suddenly a car shoots in front of you, nearly creases

driver cuts him off. But should you run to the cops?

your fender, and forces you to swerve. Good and mad, you look for a cop.

Police say the sad truth is that drivers who beef too quickly about "cut-offs" often have done something that made the other driver act that way.

So if you're tempted to tell, first be sure your own nose is clean. Troopers sometimes follow the car complained about, find he's doing all right, then come back and have a look at the fellow who complained.

"Sometimes," they say, "he's worse than the guy he complained about."

A good clue: If you're sure you didn't invite the cut-off, and if you see the same car endanger other drivers, then you may want to stop when you see a trooper and say, as some drivers do, "You may want to check that fellow."

The trooper may ask your name. Even if he doesn't, it's a sure bet he'll note your tag number. Roadside complaints like this sometimes are made by soreheads, but quite often they do result in the arrest of drunks, unlicensed drivers (who, as a group, are dangerous), and even criminal fugitives.

The fellow who won't let you pass

A car overtakes you at 60 m.p.h., then blocks you. He slows to 40. You try to pass. He shoots up to 70.

You get back in line wondering, "What goes?"

He drops his speed to 30. Angry, you're tempted to report him to the first patrol.

Should you?

I got the answer from Pennsylvania's Commissioner McCartney. This sort of thing happened, he said, to a man driving from Ohio to Harrisburg, Pa. Another driver overtook him at 60, cruised alongside annoyingly, then shot ahead—and slowed down. This went on for miles.

"I decided," the motorist said, "that he was trying to make me mad and force me into a race." The motorist stood it awhile, then wrote down the other car's number. Next day he telephoned back to police in western Pennsylvania.

"I want that man arrested on my complaint," he said. Police obliged, went to the driver's home and arrested him. A very surprised driver sheepishly admitted what he'd done. The "motorist" he'd tried to race was Commissioner McCartney himself, in business clothes.

When a car passes you on a blind hill

A car races wildly up the wrong lane, endangering your life, risking a hilltop tragedy. You see a trooper. Should you report what happened?

"Absolutely," says Pennsylvania's Maj. John D. Kine. "That fellow's the kind of killer who shouldn't be on the road. If he passed on one hill, he'll do it again."

Here's what to do: Get his license number and the make and model of his car. (Be sure you get the number right. Too many motorists don't.) Note the color of his car. (Many drivers get so excited they can't remember, police say, whether a car was red or green, or even black or white.)

Note the location. When you see a trooper, flag him by waving, flashing your lights, blowing your horn, or stopping off the road. Even if he's going the other way, he'll come back to see what's wrong.

If you don't see a trooper, stop at the first phone. Within two minutes, patrols will be notified.

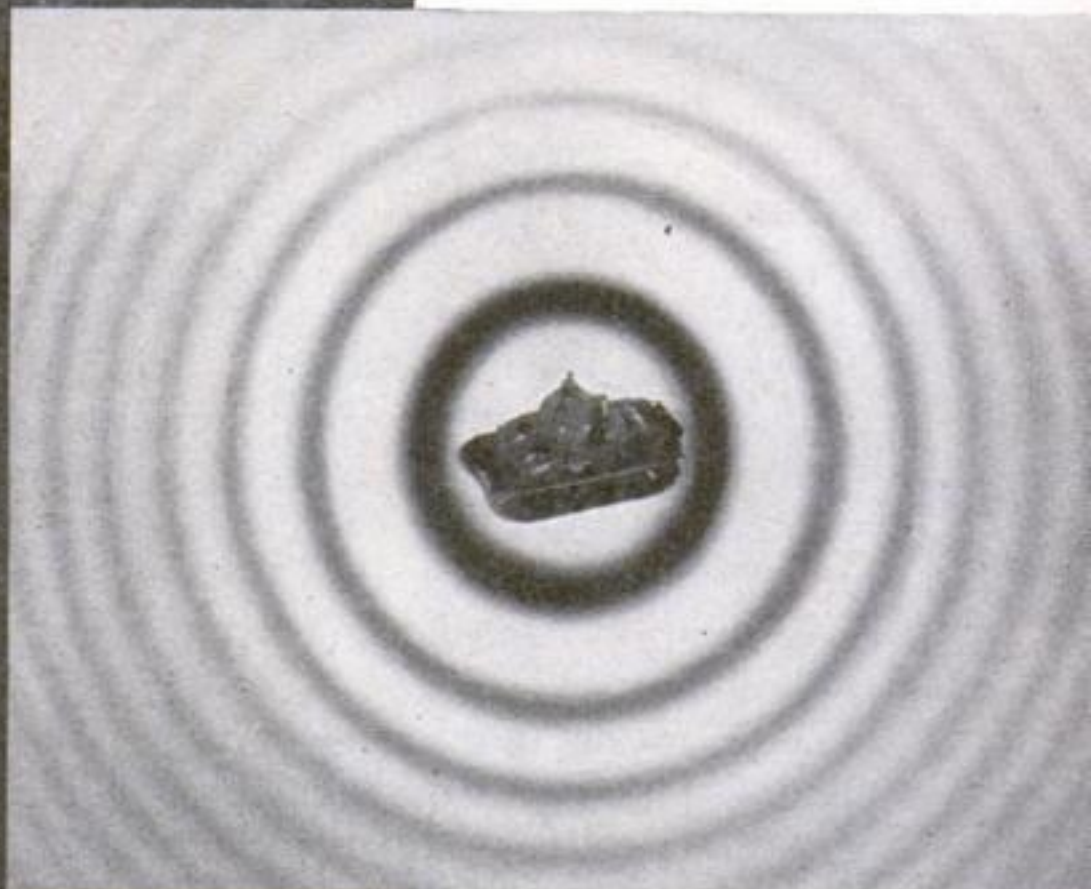
Careful, here! Police get many reports on "speeders" who aren't speeding. Reason: Cars often appear to be going faster than they are—especially when accelerating. Some tire sounds also create an illusion of excessive speed. But the main cause of error, police say, is speedometers. In Connecticut, a motorist on a 60-mile road complained that a car was going "over 70." His own speedometer proved to be 15 miles an hour too fast.

People in small towns often complain of "out-of-town" speeders. When radar is set up, the only speeders arrested often prove to be local people—and sometimes the complainers themselves.

[\[Continued on page 194\]](#)



Deadly gaze of the helicopter pilot at left automatically aims his weapons at target in new sighting system. He then presses firing button on his control stick to make the kill.



Looking through sight on helmet visor, pilot simply turns head until he sees target centered in pattern of concentric rings, as above. Then guns or missiles score a perfect bull's-eye.

Weapon-aiming helmet has a look that kills

If the wearer of this helmet looks at you disapprovingly, you're dead. The head-piece enables a helicopter pilot to aim his guns and missiles simply by staring at the target. Pressing a firing button on his control stick then makes the kill.

To face a target squarely, the pilot centers it in a dime-size sight on his helmet visor. As he turns or nods his head to do this, weapons automatically swing in their mountings and point in the same direction. That's what Army copter pilots, with their hands full of controls, have always wistfully dreamed of.

Helmet and weapons are connected by a mechanical linkage in the present version, just demonstrated by Sperry Gyroscope

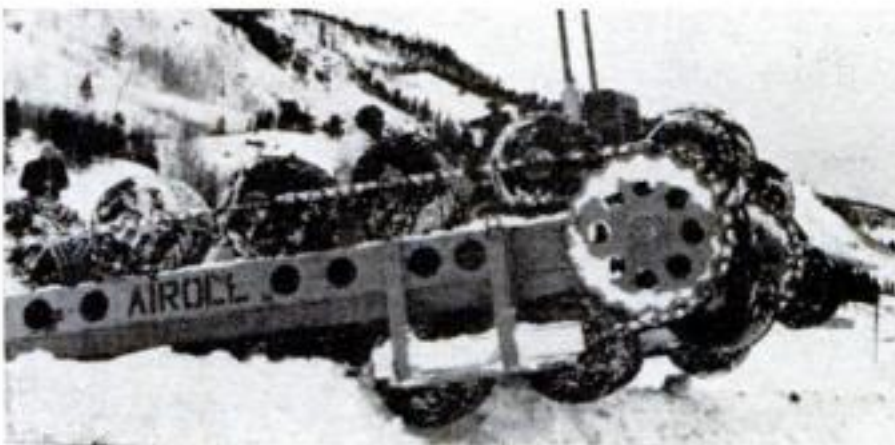
Co. Through a telescoping arm with a swiveling endpiece clipped to the top of the pilot's helmet, vertical and sideward motions are sensed by electromechanical pickoffs. The resulting control impulses, amplified much as in a car's power-steering system, actuate the weapon-training mechanism. In trials, less than two seconds were needed to sight on a target.

Lightweight and counterbalanced, the mechanical arm offers little encumbrance to the pilot; but it will be eliminated entirely in an improved optical version that will substitute light rays reflected from a mirror on the back of the helmet.

The equipment may later be adapted for fast one-man jet fighter planes.



Airoll backs easily through deep swamp mud . . .



. . . takes 12-foot mounds of 40-inch snow . . .



. . . or rolls up 60-percent slopes of fine sand.

Free-wheeling tires roll on endless chains

With 16 fat pneumatic tires free-wheeling on each of its two tracks, this 9½-ton military vehicle pulls itself with ease through deep Mississippi muck or heavy Colorado snow. The Borg-Warner wheel-and-track Airoll was tested with equal success on fine-grain beach sand.

Rated a better traveler than either conventional wheeled or tracked vehicles on

most kinds of terrain, the Airoll is a successful mating of both. On soft ground, the free-rolling tires become stationary and serve as giant cleats.

The new go-anywhere off-the-road transport was developed under contract for the Navy. Eight half-ton amphibious versions have been ordered by the Marines for use as personnel and weapons carriers.

Studebaker Camper

A cabin complete with cots, mattresses, cabinets, and picture windows is available from Studebaker mounted on a half-ton or three-quarter-ton pickup truck. With rear cabin wall and cots removed, the vehicle may be used as an enclosed panel truck.



Moon Rocket Rides Monster Crawler

Giant spacecraft on the way, outgrowing today's launching system, will use this radical new one

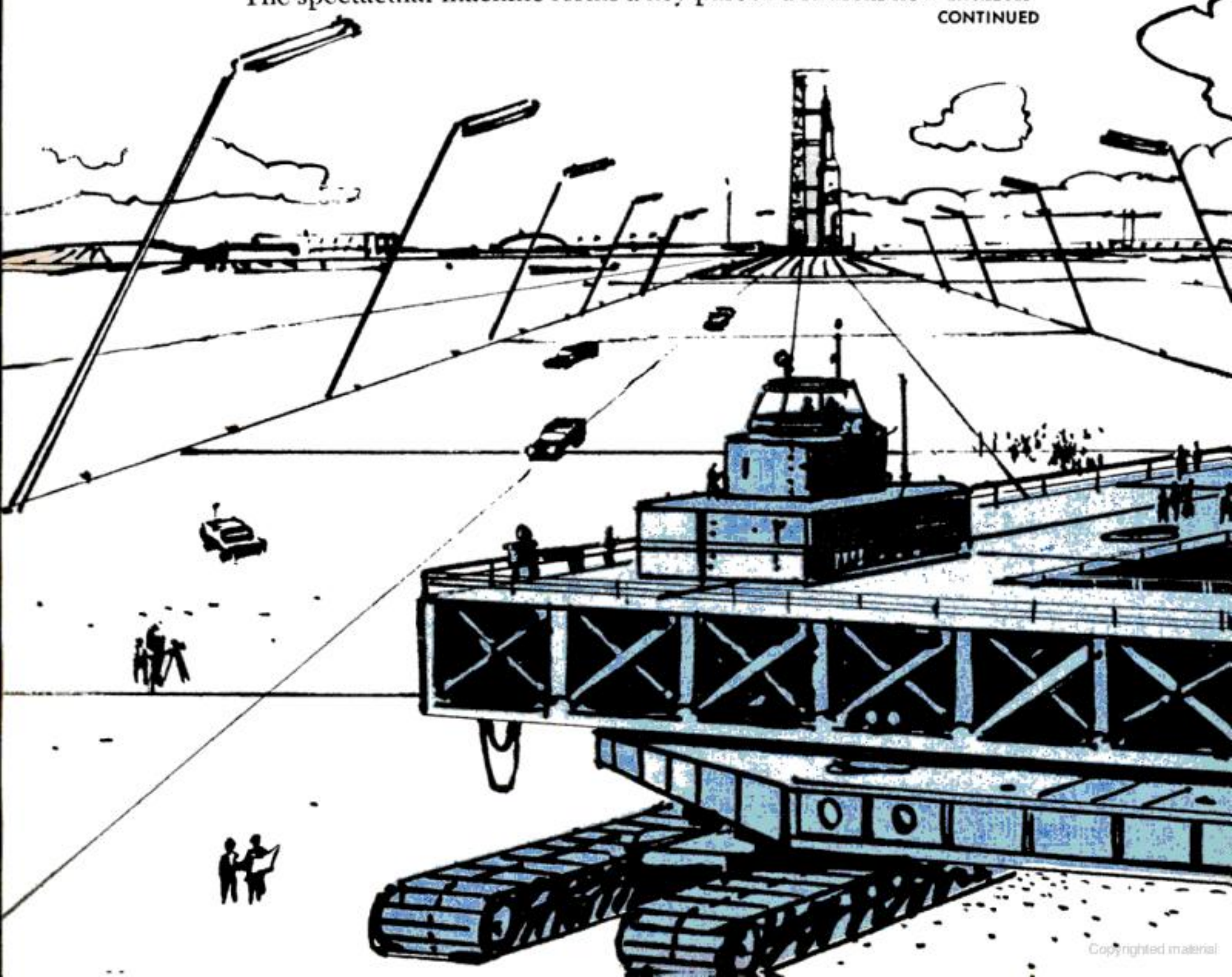
By Alden P. Armagnac, with drawings by Bob McCall

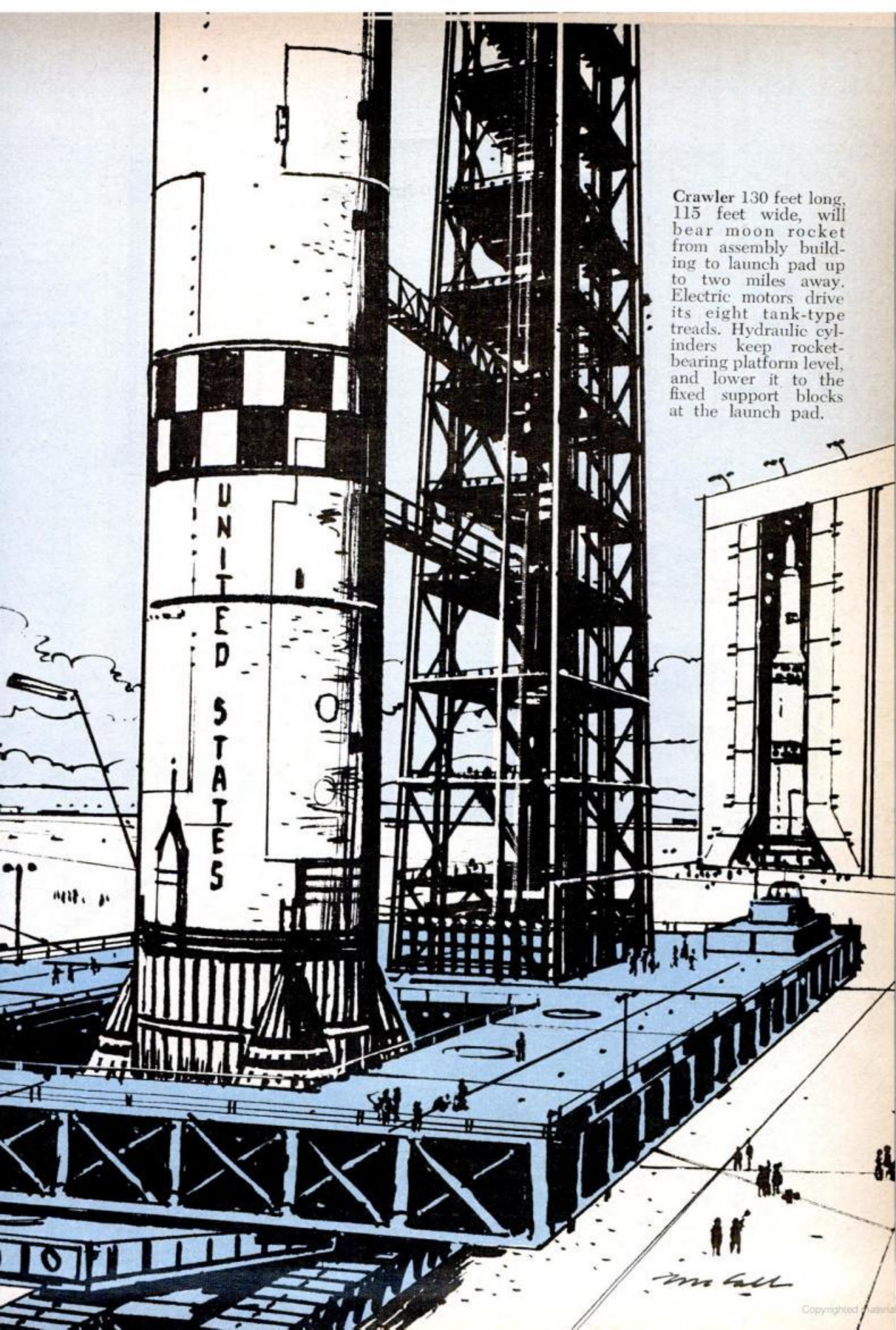
UP-ENDED on a crawler bigger than a baseball diamond, our 350-foot moon rocket will march dramatically two miles along the skyline from assembly building to launch pad.

Powered by diesel generators and electric motors, the enormous carrier vehicle will move on eight tanklike treads. It will bear the Advanced Saturn rocket and its umbilical tower on a 2,000-ton self-leveling platform, which the crawler will lower to blocks at the pad. Then it will back away to safe distance from the blast-off.

The spectacular machine forms a key part of a radical new launch-

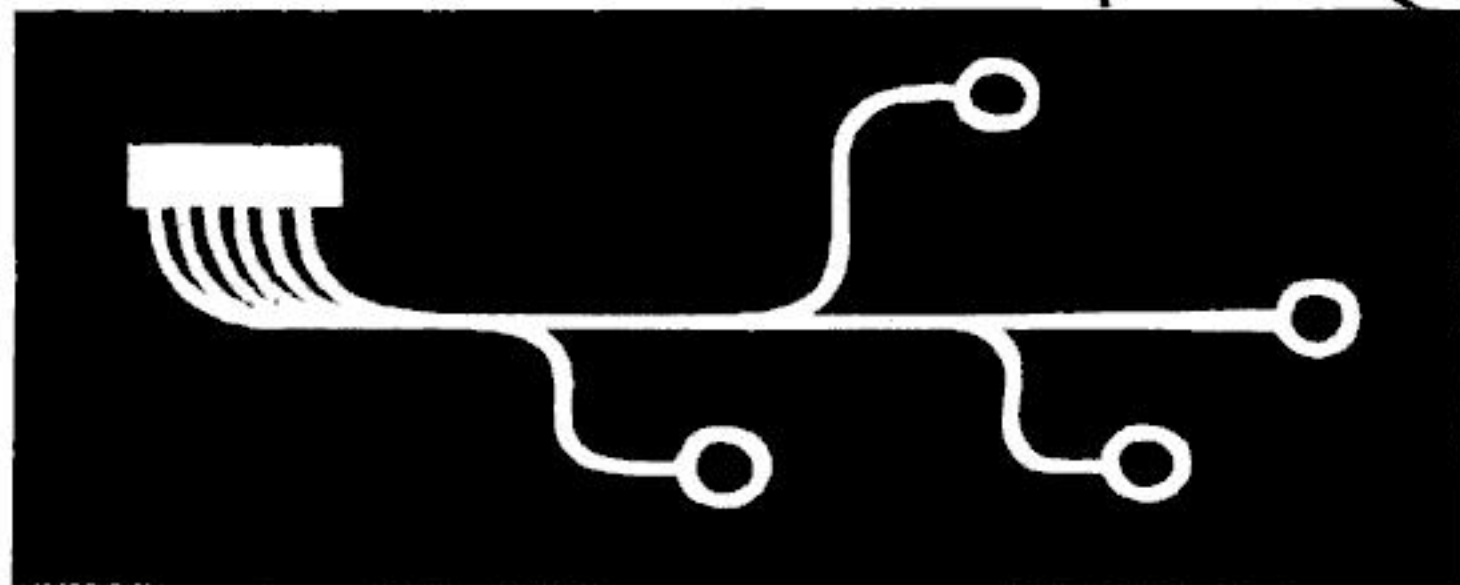
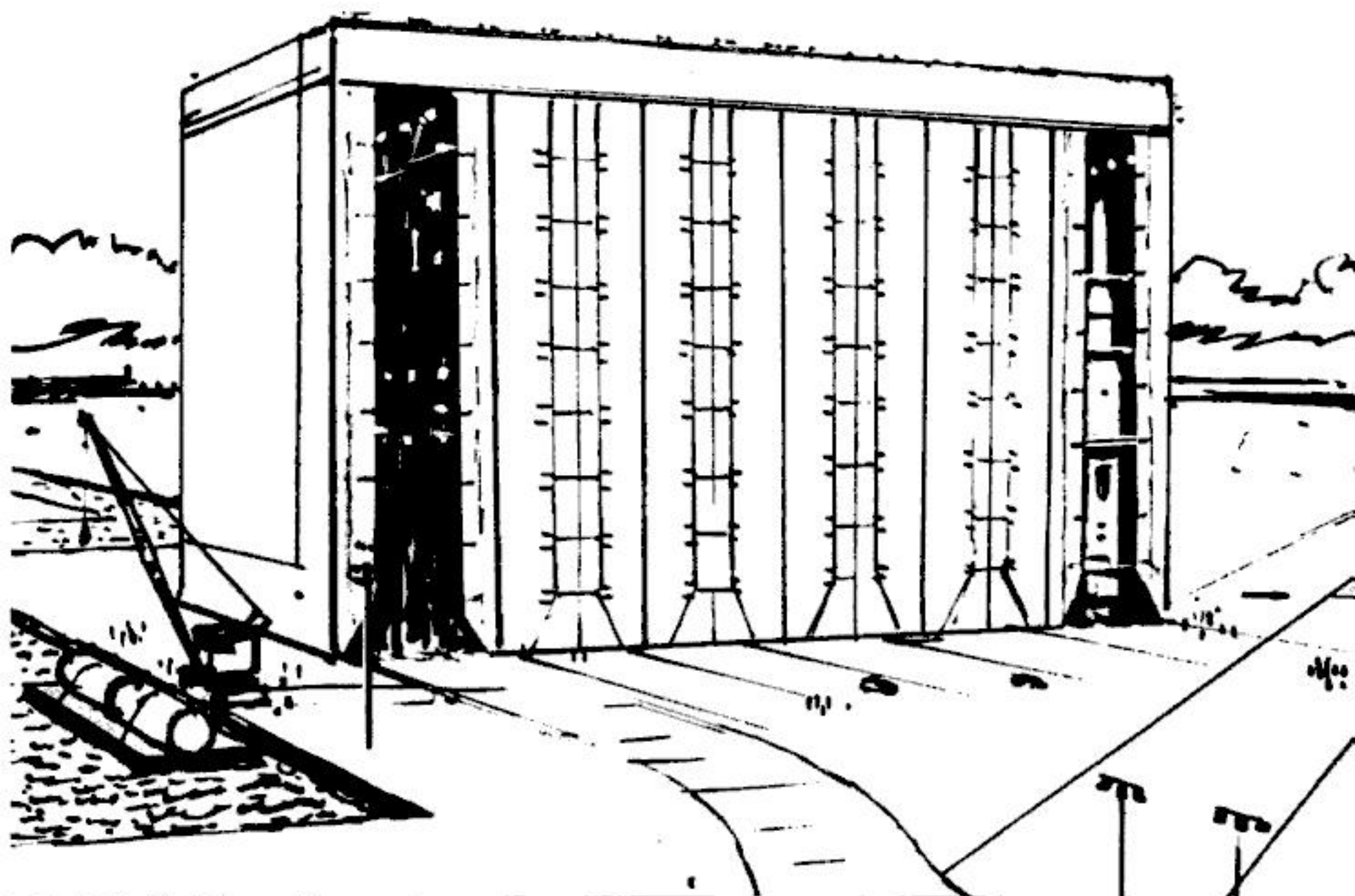
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Crawler 130 feet long, 115 feet wide, will bear moon rocket from assembly building to launch pad up to two miles away. Electric motors drive its eight tank-type treads. Hydraulic cylinders keep rocket-bearing platform level, and lower it to the fixed support blocks at the launch pad.

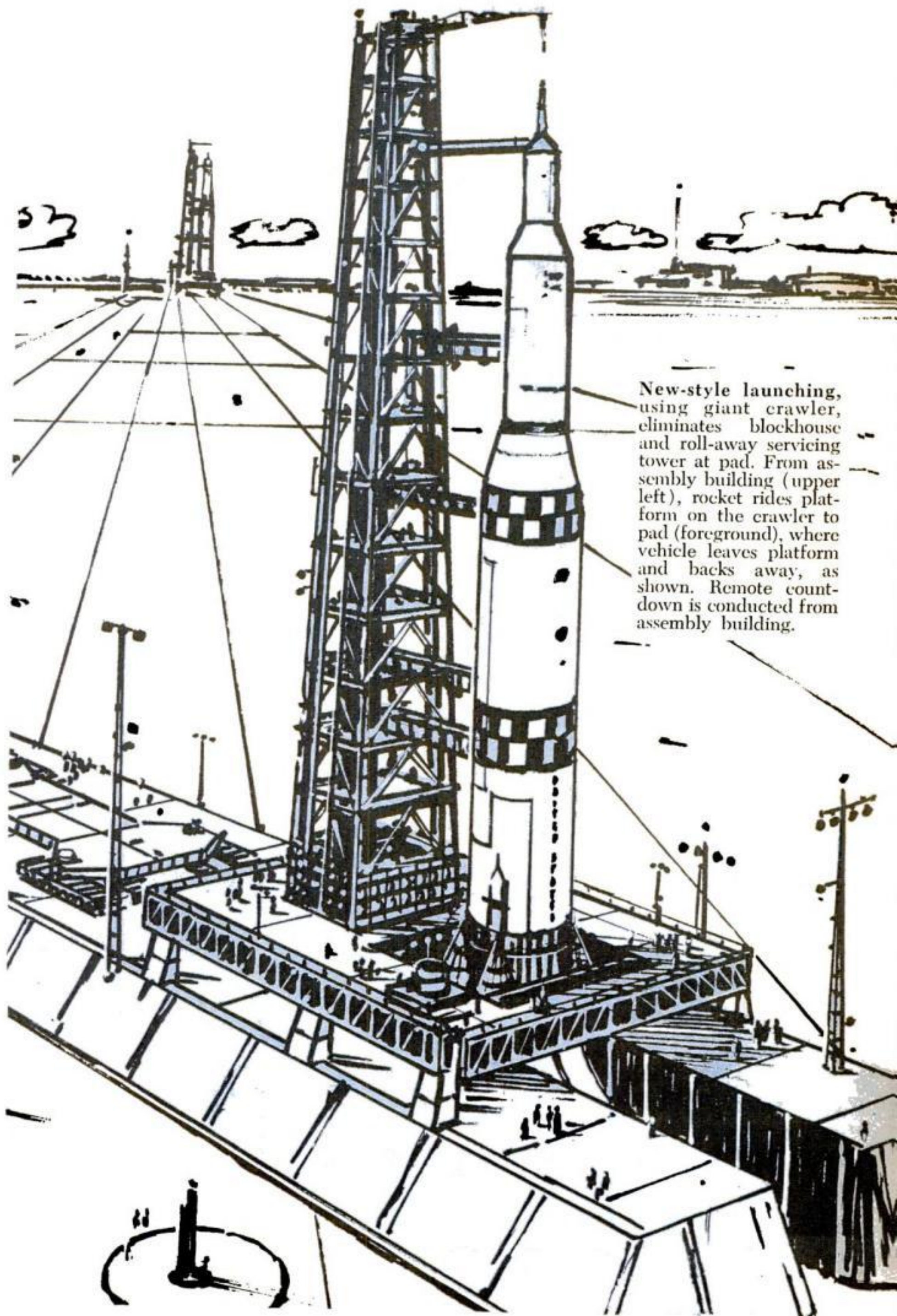
McCall



Six-bay assembly building and four launch pads will permit launching biggest rockets in rapid succession—or even in salvo of several at once.

ing procedure, required by coming super-rockets' colossal size, and due for use by 1965 in the Advanced Saturns' about-to-be-constructed "Complex 39" at Cape Canaveral, Fla. Arriving in sections by barge canal, the $7\frac{1}{2}$ -million-pound-thrust rocket will be assembled in a 48-story-high building housing six at once. Almost completely checked out for launching before being borne to the pad, it will simply be fueled there—and the launching countdown will be completed from the distant assembly building.

Made possible by new computers operable over long lines, this remote countdown eliminates a blockhouse. Gone, too, will be the usual huge servicing tower that rolls away from a pad at launching time; for the Advanced Saturn, such a mobile structure would be prohibitively big and costly. ■ ■



New-style launching, using giant crawler, eliminates blockhouse and roll-away servicing tower at pad. From assembly building (upper left), rocket rides platform on the crawler to pad (foreground), where vehicle leaves platform and backs away, as shown. Remote count-down is conducted from assembly building.

Jim Roe Tests the Bertram

Popular Science finds this new breed of fast, deep-keeled boat as adept at family cruising as it is at racing

BIMINI, BAHAMAS

WE'VE just tied up in this deep-sea fishing capital after a high-speed, never-slow-down run across 50-plus miles of open Atlantic.

We left Port Everglades, Fla., just two hours and 18 minutes ago, in Dick Bertram's personal Moppie—a 31-foot fiberglass hull of new design.

These Bertram boats are now made in three hull sizes—a 25-footer (shown under test at right), a 31-footer, and a new 38-footer.

But no matter what the size or type of power, the thing that sets a Bertram apart is a distinctive hull.

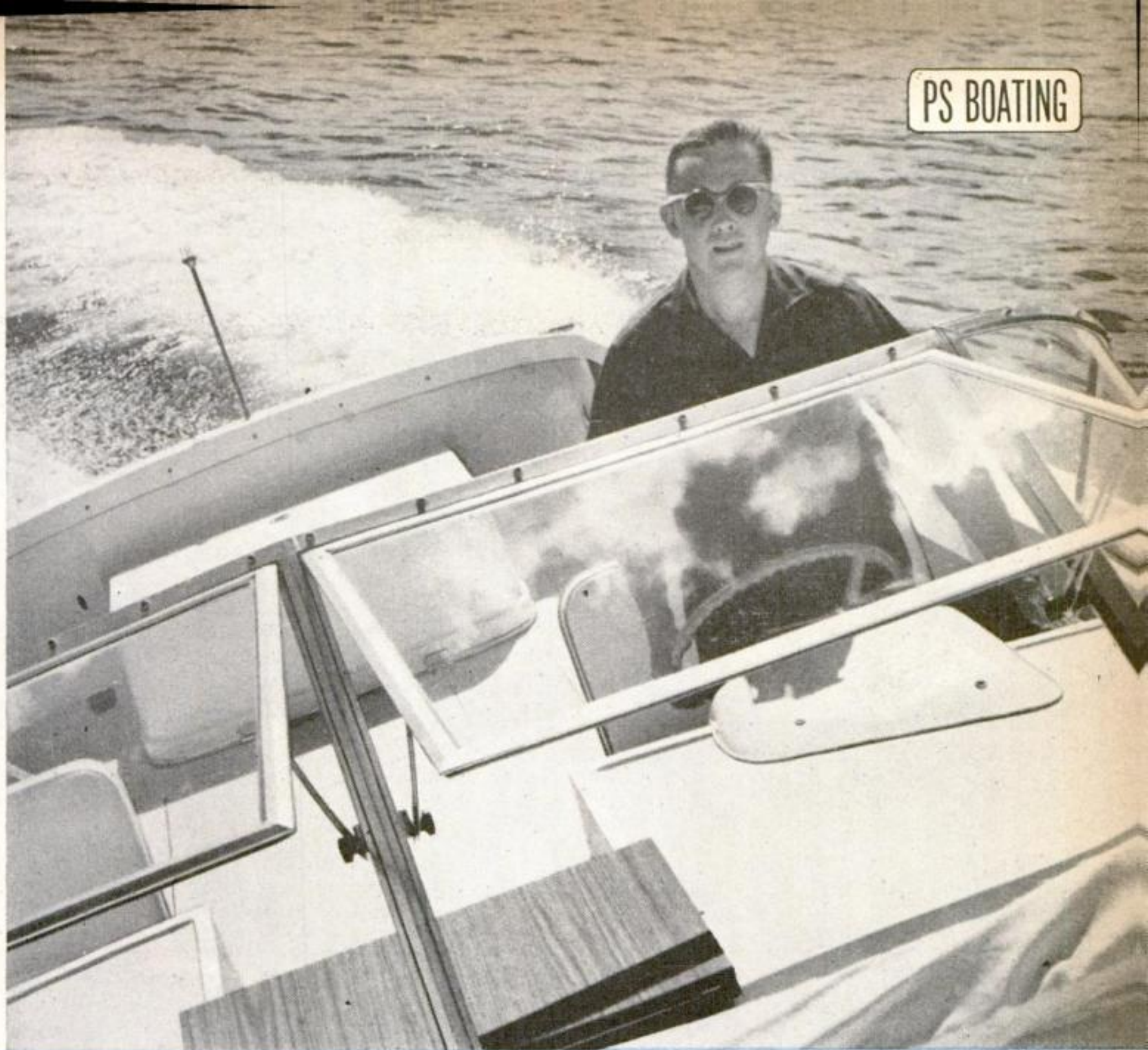
This hull has shown its deep-V transom to dozens of competitors lately in open-water races. Nothing has been able to stay in sight of it in the Miami-Nassau



High speed turns: a cinch. My son Jim and I

Swish: This photo, taken directly down over the transom of a speeding Bertram shows distinctive wake, created by V keel and longitudinal lift strakes running entire hull length.





found it merely hunkers down and *turns*. Centrifugal force holds you in place.

The secret: Fore-and-aft view of Bertram 25-foot hulls shows the deep-V keel—extending clear to the transom—and the longitudinal strakes that give Bertram boats their unique performance. Hull is a successful hybridization of displacement and planing types.

By Jim Roe

PHOTOS BY HARRIET ARNOLD



Moppie's 560 horses put long stretches of the Atlantic behind us



Speed and stability are two of the marks of a Bertram. In the Gulf Stream off Bimini we put the 31-foot Moppie through a series of high-speed maneuvers. Even in hard-over turns at 34 m.p.h., in confused seas, she handled like a lady. A seaworthy craft for all-family cruises.

race. It came in first in its class in the London Daily Express Offshore Power-Boat Race in the English Channel. And our own test boat's cousin, Blue Moppie, averaged an incredible 35.5 m.p.h. for the 1,257-mile run from Miami to New York in mid-August. This grueling run, offshore in the Atlantic, broke a Miami-New York record held by Gar Wood for the last 41 years.

But we are not here in Bimini now for racing. We left our own boat in Chicago's Burnham Harbor and came down to test-drive these Bertram bombshells under conditions you and I would encounter if we owned one.

It didn't take long to discover we were in a boat that's different. As we cleared the Port Everglades buoy we nosed into a chop from the southeast: short waves, running four to six feet trough to crest. Not really rough, but sloppy and coming in from starboard, forward. Enough to make drivers of most boats choose between slowing down or pounding the daylights out of boat and passengers.

We didn't have to choose either of these alternatives. Bertram sales manager Dub Hosler advanced the throttles of the twin 280-horse Chryslers to 2,600 r.p.m., steadied Moppie on a course of 121 degrees, and settled down to wait for Bimini to climb over the horizon. We didn't touch those throttles for 50 miles. Since Moppie was going through the water at about 23 miles an hour at this throttle setting, there were moments when there was lots of spray flying—particularly halfway across as we passed over the axis of the Gulf Stream. Here one can expect (and we found) big, lumpy swells coming from every which way. But Moppie didn't pound once. She didn't yaw. She didn't roll. She didn't porpoise. She just sliced right on.

We were members of a 75-boat cruise, sponsored by the Marine Industry Association of Broward County, Fla. Starting time was 6:00 a.m. We came out in the dawn and saw the main group off. Then we came back to assemble the balance of our crew and made our own depar-

fast. This is where Bertrams first proved their rough-water ability



Boating is a family sport: A safe, high-performance boat lets you take your family to sea with confidence. My wife (left) and our daughter Patti helped test the Bertram on these runs.



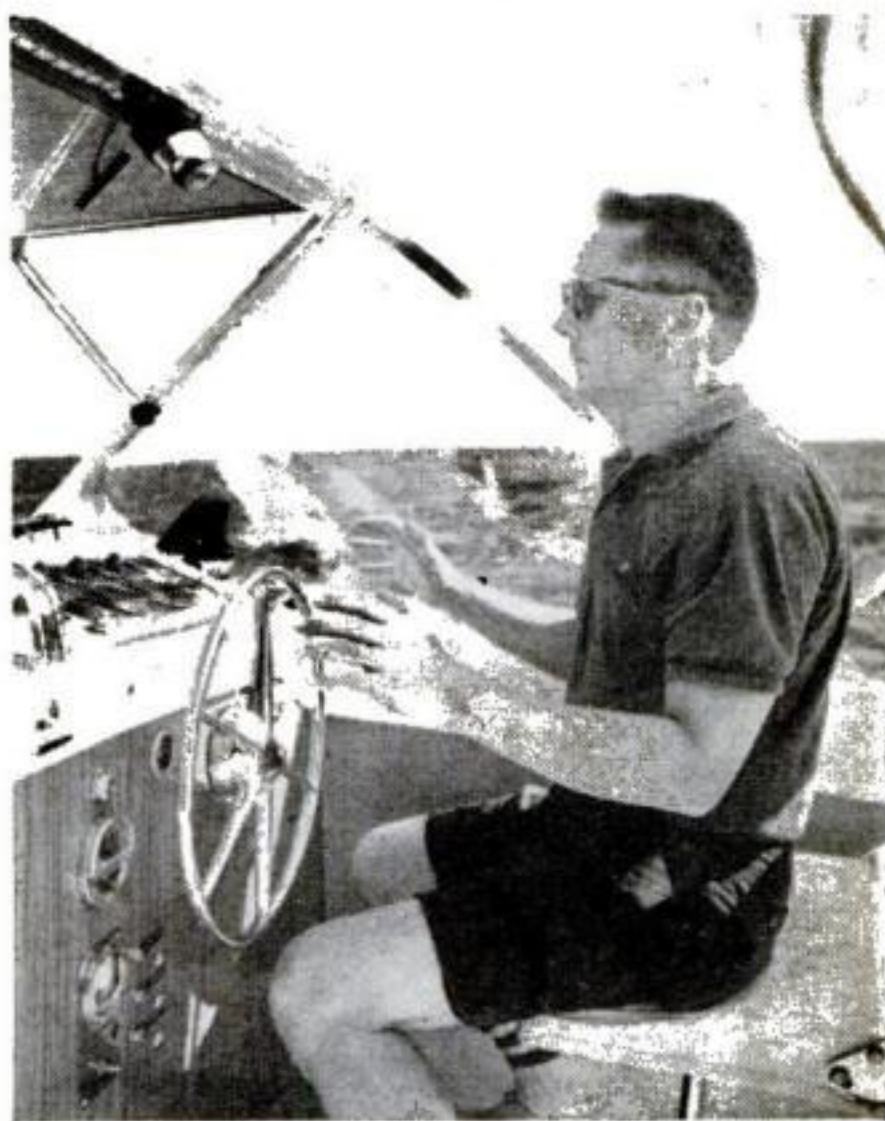
Test runs included the open-ocean one from Fort Lauderdale to Bimini and back. Others were made in the Gulf Stream off Bimini and in canal and lake waters at Miami.

ture at 9:00 a.m. Though we left three hours after the other boats, we were well up among the early arrivals.

This boat that gets you there first even when you're not hurrying was designed by C. Raymond Hunt of Marblehead, Mass. The Bertram Yacht Company has the exclusive rights to the design in boats over 23 feet in length. It is a successful hybridization of a displacement hull (basically a deep-V keel extending clear to the transom) and a planing hull (one that will ride up and plane on top of the water at speed). The photographs show at a glance how Ray Hunt managed to combine features of both hull types into one. The deep-V keel goes clear to the stern, giving the boat a completely different stern view than any previous high-speed power boat. This depth gives the Bertram stability and seaworthiness.

Yet she planes, due to the four longitudinal strakes running from the bow to the stern on each side of the hull.

Obviously, this design took some thought to develop. But once all the



Straight and true: That's the way Moppie went with my hands off her wheel. Deep-V keel helps her stay on course in quartering or following seas, makes her safer, easier to drive.

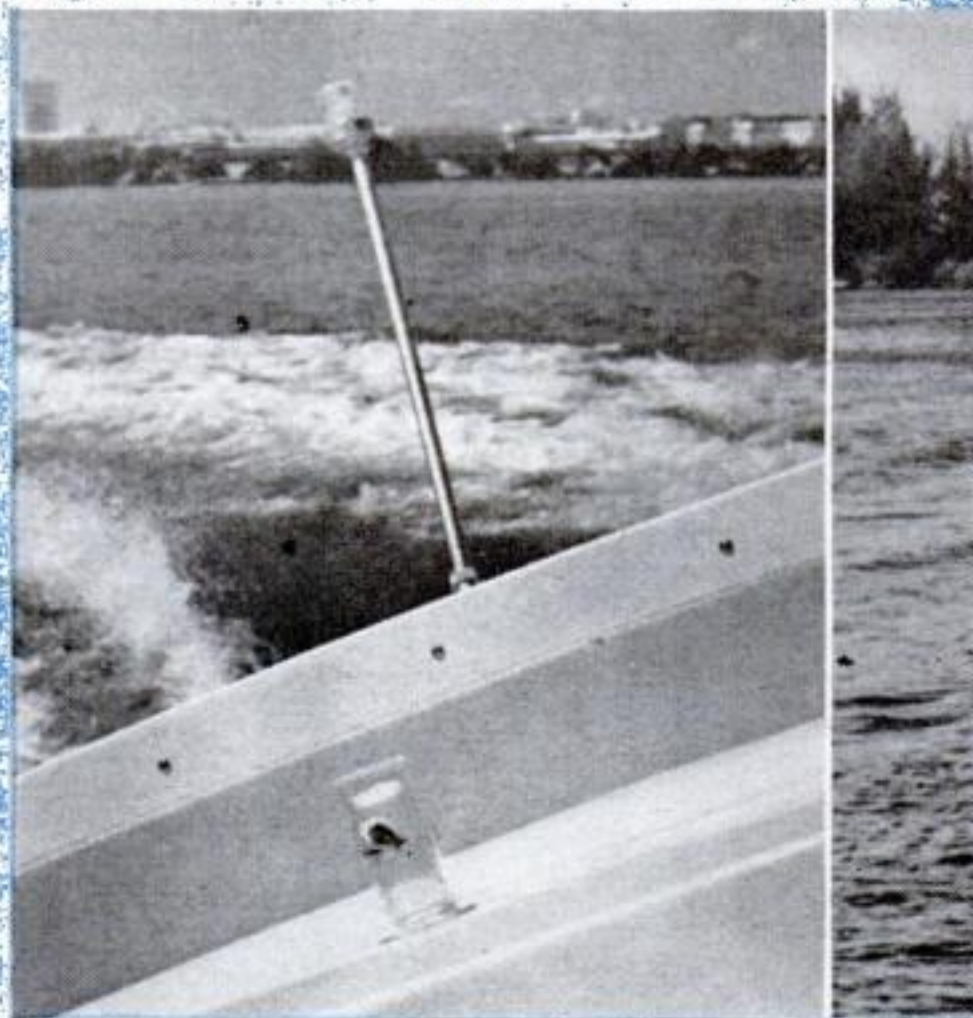
The Bertram handles as well as it looks. This 25-foot model showed

It doesn't spill: Plastic tumbler—full of water—is sitting atop the slick fiber-glass engine housing. With twin engines at 4,000 r.p.m., wheel was spun hard over. The tight turn completed, not a drop of water was spilled.

FORT LAUDERDALE

WE CAME back from Bimini in even better time than on the outbound trip. Waves were down to a couple of feet in height, so we set the throttles at 3,100 r.p.m. I had the wheel, and again we didn't alter the throttle setting for the whole 50 miles from Bimini to the harbor approaches of Port Everglades. So we made the trip, at a steady 28 miles an hour, in just an hour and 50 minutes.

On this particular weekend trip the seas were rougher on the way out than on the way back. Often, it's the reverse, with fine weather at the start of a family cruise, but deteriorating conditions on the return trip. I couldn't help but reflect how comforting that deep-V stabil-



ity and the high speed of our Bertram test boat can be to a family skipper. For any boating trip involves going *and coming home*. The Bertram's speed would allow us to outrun some storms if we

figuring is done and the boat is built, it's easy to understand what happens: The strakes allow you to plane and make speed, the deep keel gives you stability. Therefore you can install more power, and go faster safely in rough water.

Safe turns at high speeds. We tried this repeatedly. The boat merely hunkers down, banks itself into the turn, presses you down into your seat with centrifugal force—and starts going in the new direction. The science of the thing is all down under water. The deep hull and the vertical surfaces of those strakes hold her from sideslipping or tipping.

We even tried the water-glass test. We took a tall plastic tumbler, filled it, and placed it on the slippery fiber-glass engine housing of the inboard-outboard. I got both engines purring nicely at

4,000 r.p.m., then spun the wheel to starboard, all the way. When we straightened out, that glass was still there, straight and sassy as you please.

No nose-diving. On most normal high-speed boats, you will get lots of excitement and quite possibly a swim if you suddenly chop the throttles from top speed back to idle. Dub Hosler told us we could do this even with the Bertram 25 and have no problems. Dub looked honest, everything else had worked as he said it would—and besides, we knew how to swim. So we did it.

The result was a terrific anticlimax. Nothing happens. The boat merely slows down, gradually. There's no big rush of water chasing the stern. Since this was so much fun we tried combining full-speed turns with throttle-chopping right

us many neat tricks that demonstrate stability of the hull design



This Bertram 25, powered by twin outdrives, is roomy and able. Two bunks, lockers are forward.

were near port when they approached. The stability would help us ride out rough seas if we were caught offshore. Racing boats are driven by experts, who don't take their wives and children

along. But the speed, the seaworthiness, and the dependability these boats have displayed in open-water racing means any family-boat operator will have fewer problems and more peace of mind.

in the middle of the turn. Again, nothing happened. We slowed down with no fuss at all.

Good control at slow speeds. This is a handy feature when playing a fish, and especially when approaching a dock with a tide running or wind blowing.

A level ride. The hull planes along its entire length—on its longitudinal strakes—as opposed to many planing boats that plane just on the flat hull area at the stern. As a result, a Bertram keeps her nose down and planes level.

Steady going in a following sea. We did not encounter this condition in our test of the Bertram. But others who have handled Bertram boats report they hold their course very well indeed. The deep-V hull section at the stern steadies a Bertram under following sea condi-

tions, and helps to prevent broaching.

The ruggedness of Bertram boats has been proved many times. On one occasion two Bertrams were cruising together and became separated in poor visibility conditions. The lead boat turned back to find the other one, and did—head-on. They made port, with minor damage.

In last year's Miami-Nassau race a Ford Thunderbird-powered Bertram 25, driven by Bertram's engineer Walt Walters, hit a coral head at 50 miles an hour.

Walt gives this account of the mishap: "The reef was solid staghorn and brain coral and lay about six inches below the surface of the water. The boat hit the coral and crashed along for about 200 yards before the coral ground us to a stop. No one was hurt. We managed to push the boat back across the coral to

Here's how a Bertram is built. Reinforced fiber-glass in multiple

MIAMI

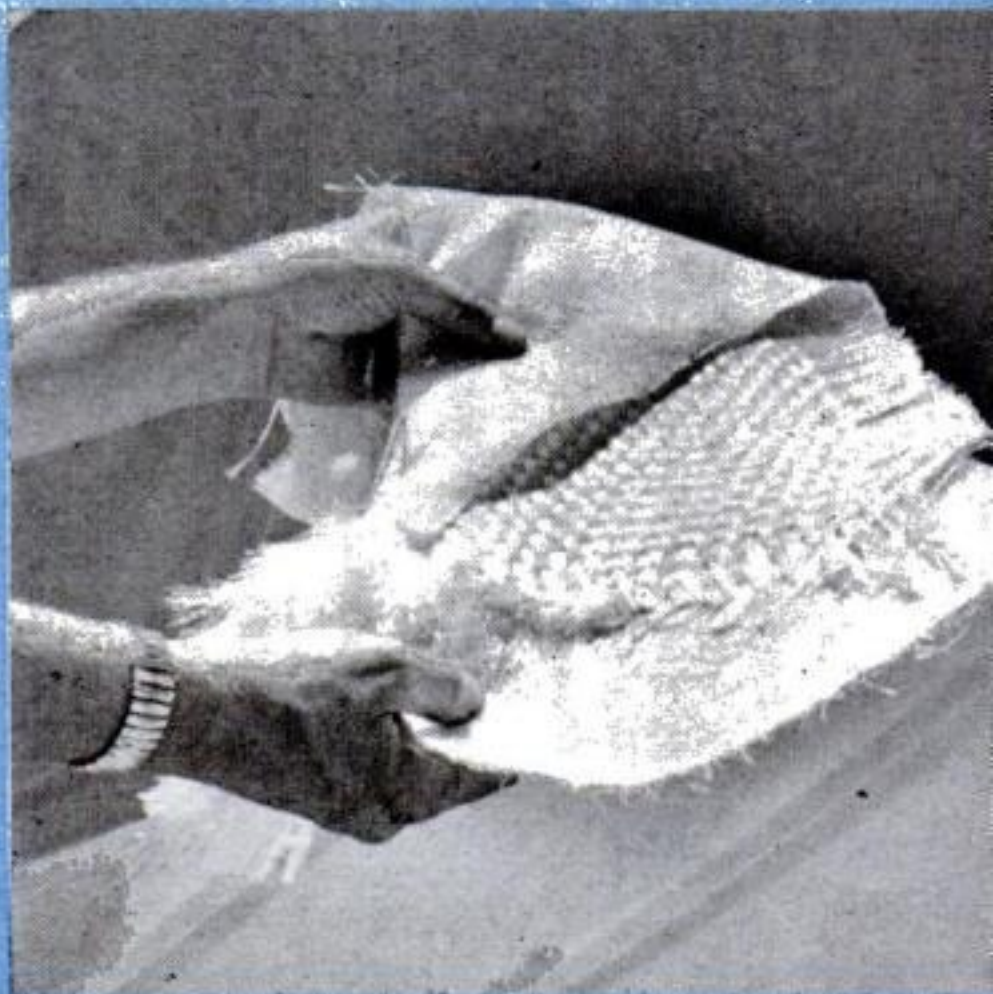
MOST boatmen love to peek under floorboards. They like to know how their boat is put together—to help judge what kind of punishment it will take to pull her apart.

A fiber-glass boat is a triumph not only of marine architecture but also of chemistry. It's a fascinating sight to witness the marriage of liquid resins with fiber-glass cloth and see the resulting rock-hard hull of a boat capable of slugging it out with the Atlantic at 50 miles an hour.

First step in the making of a Bertram is the construction of what is called the "plug," actually a hull made of wood, faithfully reflecting the designer's drawings. The "form" is built of glass fibers right over the plug.

Succeeding boats are laid up *inside* the form. First step is a careful waxing of the form, just as a housewife butters a cake pan and for the same reason—so the finished boat will slide out. Then the form is sprayed with a resin-gel coat to a thickness of .020 inch. This is the *outside* of the boat and is the smooth surface so characteristic of fiber-glass boats. The color of the boat is in the gel coat.

Next, pieces of fiber-glass cloth are soaked with resin (it takes about 100 gallons for a 31-foot hull) and lapped in place inside the form. They are tucked down into corners, rolled smooth with



Raw materials: These three types of glass fiber (top to bottom: cloth, woven roving, mat) are combined with polyester resins and catalysts. Some points of hull are 24 layers thick.

brushes and rollers. All this must be done rapidly, for the resins dry quickly—some are rock-hard in as little as 10 minutes.

Different numbers of layers of glass fiber are used for different portions of the hull, depending on the structural strength required. At some points in a Bertram, there are as many as 24 layers.

Interior bracing, too, is made of fiber-glass—for strength and for complete immunity to rot and marine insects.

Finally, the hulls move down the as-

deep water and, believe it or not, we still floated and even had enough power and propeller to limp on to a nearby port. Though I don't care to do that again, it did prove the ruggedness of (1) fiber-glass, (2) the new outdrives, and (3) coral reefs."

Bertram engineers designed the 25-foot models to perform without effort at speeds to 40 miles an hour and powered

by no more than a total of 350 hp. For the Miami-Nassau race these 25s were powered by up to 850 hp., and were successfully run at speeds exceeding 65 miles an hour. The results of this super-performance have caused a revolution in the design and engineering of boats all over the world.

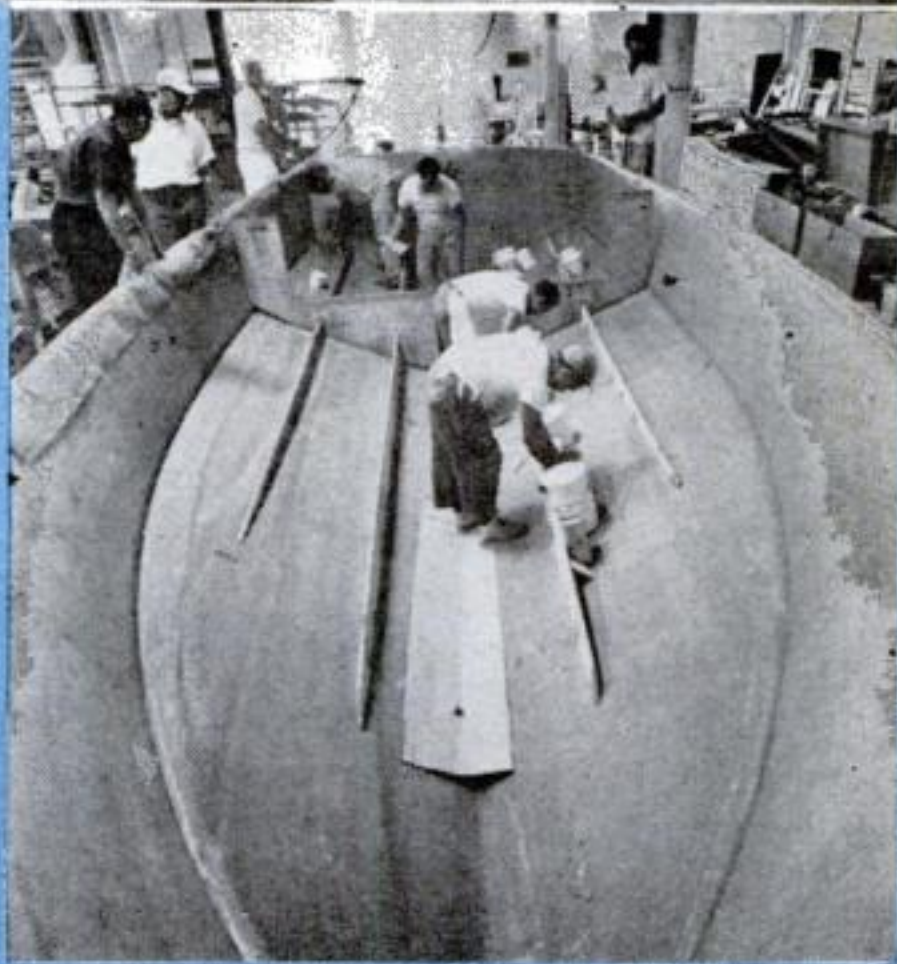
The first year one of the new Bertram boats was entered in the Miami-Nassau

layers gives a tough hull that resists shock, is immune to rot



Building, bracing a hull: Workmen above apply layers of resin-coated fiber-glass inside mold. Right, building "glass girders." Inverted U-shaped stringers give longitudinal stiffness.

sembly lines for the installation of engines, fuel tanks, controls, decking, hardware. Decks, also of fiber-glass, are laid up like the hulls, on their own forms. They are then placed on the hull, for all the world like placing a lid on a large, boat-shaped jar. They are solidly pop-riveted to the hull, then waterproofed and "welded" to the hull by the application of more sheets of fiber-glass all along the hull-deck joint inside the hull. The result is a boat that is "one-piece" construction, braced in all directions.



race, it won by negotiating 185 miles of the roughest water in which the race had ever been run. Last year—in the smoothest sea in race history—a Bertram won again (the third Miami-Nassau race win in three tries) at an average speed of 54 m.p.h. for the 185-mile run. Not many of us want to go *that* fast, but we're happy to know the boat under us can take it.

CHICAGO

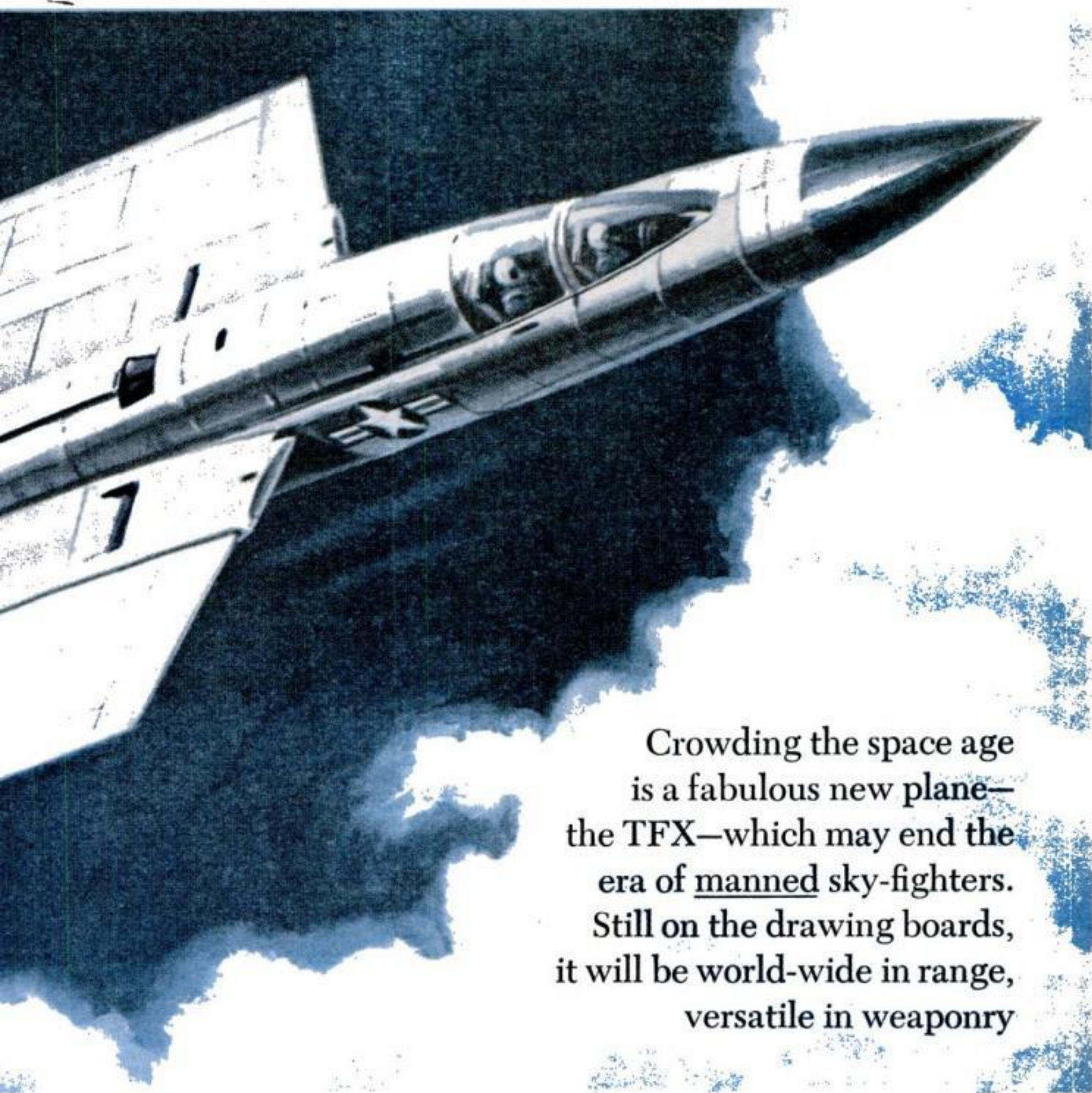
BACK home. Looking out over Burnham Harbor at a rough and rowdy Lake Michigan, we feel like addressing a "wish-you-were-here" card to Dick Bertram's boat Moppie. Her soft-riding seaworthiness would add 30 safe family-boating days a year to any season. ■ ■



Last of our red-hot bombers?

The Flying Switchblade

Variable-sweep wing, which can be moved in flight, will make the TFX a fighter-bomber pilot's dream come true. With the wing fully spread out, he can take off from and land on small fields at low speed; sweeping the wing partly back, he can cruise great distances with fuel economy; with the wing hugging the fuselage, his plane becomes a rectangular aerodynamic platform for a supersonic dash over the target.



Crowding the space age is a fabulous new plane—the TFX—which may end the era of manned sky-fighters. Still on the drawing boards, it will be world-wide in range, versatile in weaponry

By Frank Harvey

A LONG-TIME dream of aviation designers is now very close: an airplane with wings that can open or shut in flight like the blade of a knife—allowing a pilot to “shift gears” in the sky. They call it TFX—Tactical Fighter, Experimental—and every big aviation company in the U.S. and Europe has been hoping to pluck this biggest, juiciest plum left on the tree: The TFX may quite possibly be the last of the manned fighters. The winner not only gets multibillion-

dollar military orders (the TFX is intended to be used by the Air Force, Navy, and Army in various configurations) but a glittering bonus as well. The know-how gathered in government-subsidized military production can be applied to the design of civilian transports. For the variable-sweep wing is not a risky paper concept any longer. The bugs have been worked out in wind tunnels. And here is an authentic case where a designer can have his cake and eat it, too. A switch-blade airplane can slow down to land on short fields, can lift out of those short

CONTINUED

fields with a heavy load, yet can lay its wings back like a panther's ears and go supersonic when it gets upstairs in the thin air.

What will this fabulous bird be like?

- It will fly between 3,000 and 5,000 miles nonstop, without mid-air refueling, which cuts it loose from vulnerable and expensive aerial tanker fleets.

- It will have two engines (Pratt & Whitney TF30 turbofans, almost certainly) that will give it furious speeds at both high and low altitudes.

- It will have two men in the crew, either of whom will be able to double as a pilot, navigator, or weaponeer.

- The plane will be crammed with black boxes that can see through rain, darkness, and fog, warn of upcoming mountain peaks, navigate and guide the airplane to its target—then see the target, direct the bomb run, and actually pickle off the bomb.

- There will be an improved autopilot that the pilot can set and forget. During transoceanic or other long flights, the pilot and the weaponeer in the back seat can relax with a mystery novel if they desire. This feature makes the TFX a true intercontinental strike weapon—one that can take off from the U.S. and hit an overseas target nonstop, nonrefueled.

Load carrying? The new switchblade will carry a nuclear bomb in its sleek belly in addition to some eight *tons* of external stores: heat-seeking, beam-riding, or unguided rockets; and the complete line of "iron" bombs, from little frags to blockbusters.

The speed range is sensational: around 90 m.p.h. for touchdown, 550 m.p.h. for economy cruise, and twice the speed of sound over the target—plus the ruggedness for a supersonic dash through thermal updrafts at treetop level, below enemy radar.

Perhaps the most valuable statistic is the low UCI of this new flying switchblade. UCI means Unit Construction Index—three words that can have a life-or-death significance in winning or losing any brush-fire war. In general terms, the UCI of a plane is the number of days it

will take a construction battalion to lay down a runway—sod, gravel, pierced planking, concrete, or what have you of sufficient length and strength to handle that given aircraft.

A low, low UCI. The TFX's UCI is secret, but it is reliably reported to be the same as the old World War II workhorse, the twin-engined C-47 Gooney Bird, which uses sod fields with no problem. Why is this important?

Here's an example:

A big country in the Far East that we'll call Aggressorland, starts eyeing its little neighbor, Neutralia, with a greedy eye and decides that "the two nations must join hands in progress."

There are four 10,000-foot reinforced concrete runways in Neutralia, built with U.S. funds and capable of handling supersonic F-100s and F-105s of the Tactical Air Command. When Neutralia gets panicky and sends out a call for help, and TAC's Composite Air Strike Force pilots leap off in their jets, the clever little agents of Aggressorland plant large bundles of dynamite under the only four runways on which these jets can possibly land. They wait until the jets are almost there—and blow the four runways sky-high. This means that our strike force has to land at some place like Clark Field, in the Philippines—1,000 miles from Neutralia. It's pretty hard to provide close support to a ground battle from a field 1,000 miles away.

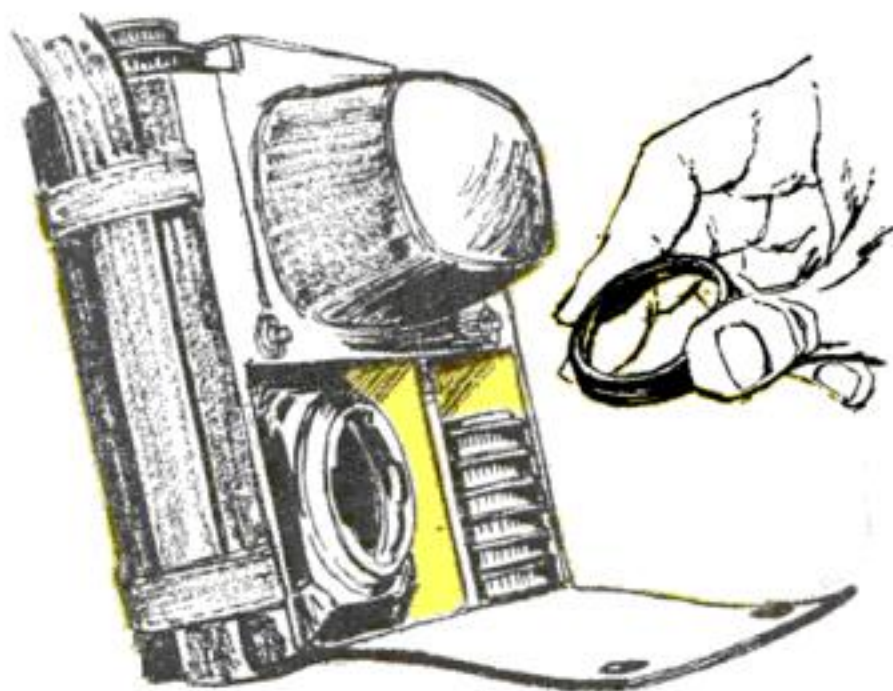
Runway ready. Suppose, however (as will be the case in about three years), the U.S. Strike Command has a force of TFXs ready to fly to the aid of Neutralia. The Aggressorland agents blow the four runways to bits—and it's inconvenient, but not a disaster. Army combat-construction units are air-dropped—complete with bulldozers, scrapers, graders—at the spot where it's considered the TFXs can operate. The engineers get there, maybe 20 hours ahead of the switchblade fighters. By the time these planes buzz into the traffic pattern, there's a nice field waiting for them.

This example is an extreme one. There

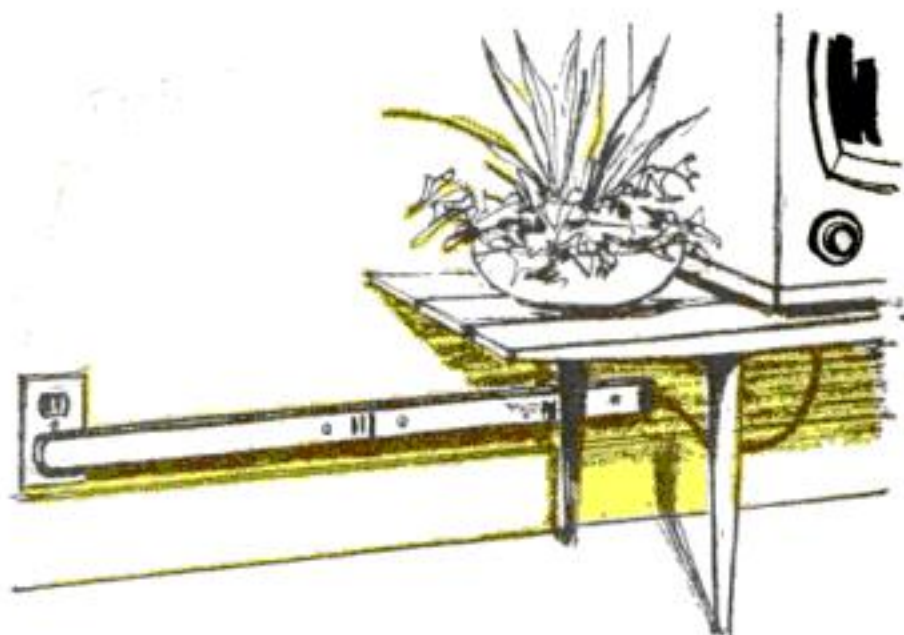
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"I'd like to see them make..."

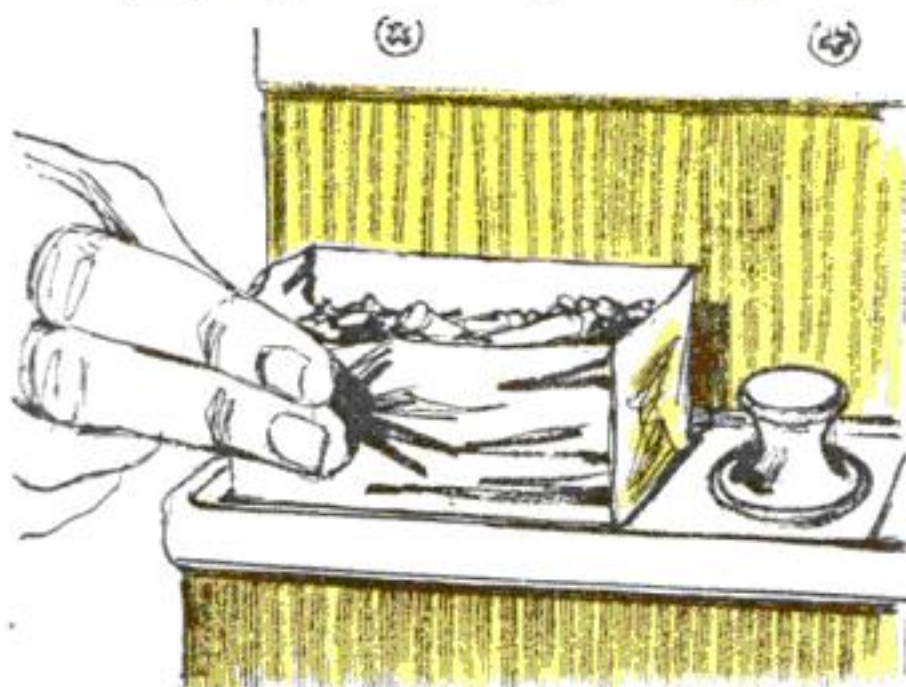
A pot-saver switch on stoves. A housewife would set it before leaving the kitchen to answer the door or phone. All the burners would go off automatically in 10 minutes.—S. N. Stresnic, Fort Lauderdale, Fla.



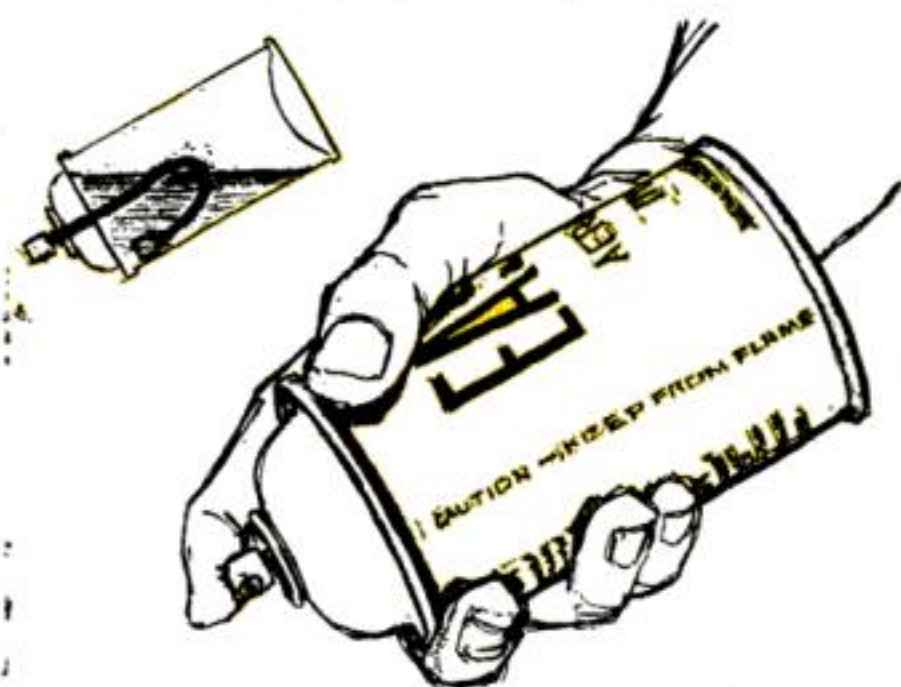
A combination carrying case for 35mm cameras. A lower compartment would hold accessories that usually hang from the shoulder straps or bulge your pockets.—George Galloway, NYC.



A plug-in bar with add-on sections, to do the job of electrical molding. You'd plug it in and anchor it flat to the wall to "install" new outlets.—R. H. Morgan, Towaco, N.J.



Lift-out foil liners, made in standard sizes, for automobile ash trays. Also a tray designed for home use and sold with replaceable liners.—Mrs. C. E. Wilson, Vanceboro, Maine.



Spray cans with a flexible feeder tube inside, weighted at the end. You could spray with the can tilted in any direction and get out all the contents.—Steve Solovitz, St. Louis.

Everyone has his own pet idea of a gadget that he would like to see in general use. What's yours? We will pay \$5 for each one published. Please use Government postcards

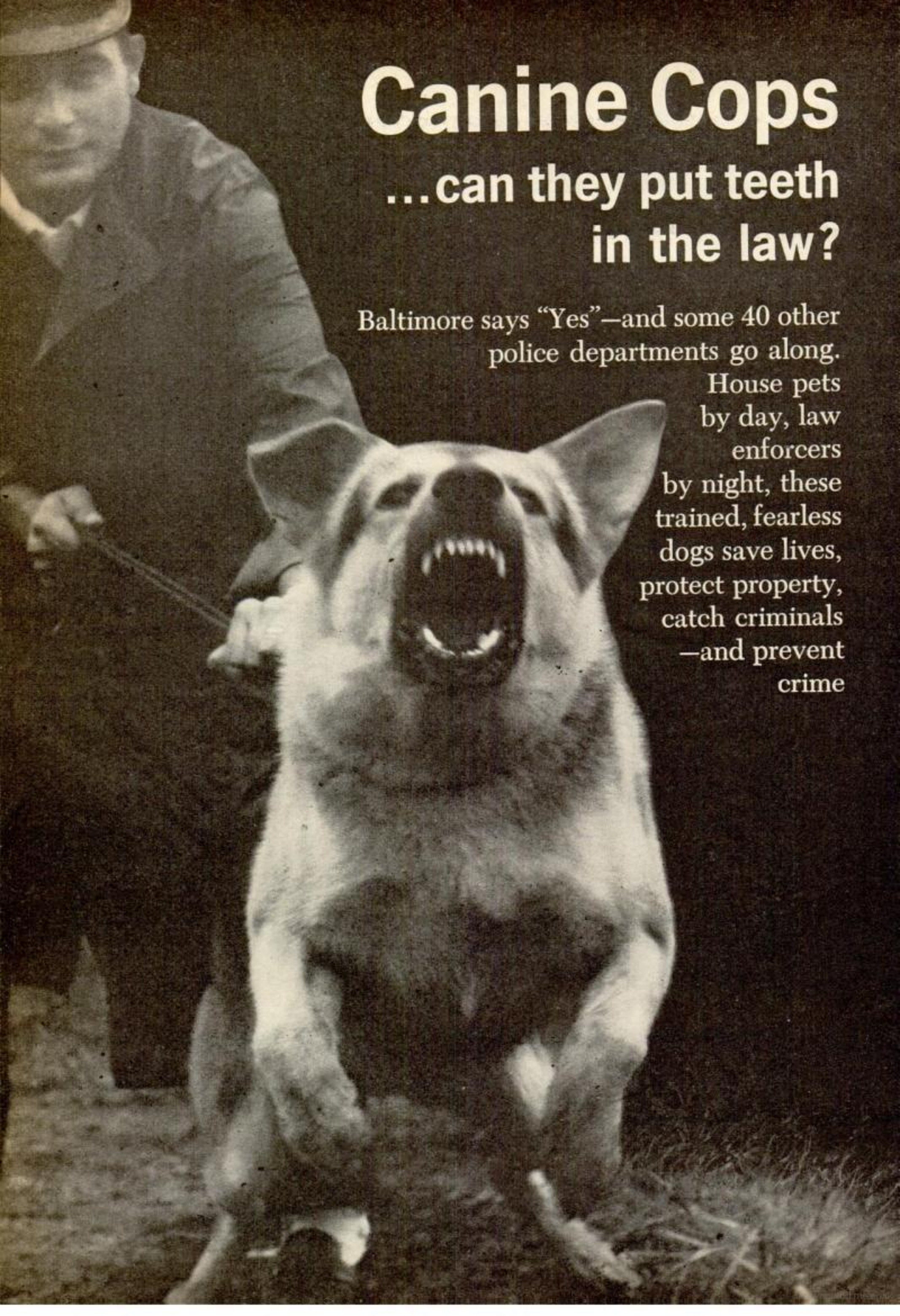
only. Send to ILTS Editor, Popular Science, 355 Lexington Ave., NYC 17. Write your name and address clearly. Contributions cannot be acknowledged or returned.

Canine Cops

...can they put teeth
in the law?

Baltimore says "Yes"—and some 40 other
police departments go along.

House pets
by day, law
enforcers
by night, these
trained, fearless
dogs save lives,
protect property,
catch criminals
—and prevent
crime





Keeping culprits at bay is one important job for a four-pawed flatfoot. Arresting officer can

even walk several blocks to a call box without fear that his prisoners will escape.

By Robert Gannon

THE police dog came closer. The still Maryland air carried cleanly the sounds of his panting and sniffing as I crouched, hidden behind a thicket. Suddenly, he saw me. I started to run, then turned just as the dog pounced. His angry teeth clamped onto my right arm, and 120 pounds of snarling German shepherd threw me to the ground. He stood over me growling and gripping my arm till the police arrived.

Fortunately, I had prepared myself with thick, protective arm padding; the wolf teeth failed to penetrate. Nevertheless, I was glad to hear the trainer say, "Okay, Vic. That's enough."

The big dog let go, sat down in front of me. "Shake hands, Vic," said the trainer. And the dog, a moment ago a man hunter, waved a paw at me. Gingerly I shook it.

I was at the Baltimore Police Department K-9 Corps training compound, and had just witnessed a police dog's fantastic tracking ability—one of the many jobs these highly trained animals can do.

Seven years ago no U.S. city had dogs on its police force. Today some 40 or more use them for everything from find-

ing lost children to handling riots. In Baltimore, man-dog teams roam the town night and day, and since the K-9 Corps was installed the city is one of the few in which the crime rate has dropped.

"The dog is the most potent, versatile weapon ever invented," says Sgt. William H. Kerbe, one of Baltimore's two trainers. "You can't shoot around corners, but dogs can go anywhere you direct them—like guided missiles. They never lose races." Little wonder: They have been clocked at 35 m.p.h.

Police canines aren't trained to kill, but to bring down and hold a man until the police arrive. By day they're pets, living at home with their policeman-owner. At night they're respect-demanding four-footed cops.

Shepherds take orders. Baltimore and most other cities use German shepherds exclusively. According to Capt. G. Gordon Gaeng, K-9 Corps commanding officer, shepherds are intelligent, strong, learn quickly, take directions easily.

Dobermans make fine police dogs, too. But there's one major trouble: They're slashers. Instead of grabbing and holding, they "go down your arm like they're eating an ear of corn," as Captain Gaeng puts it.

Some of Baltimore's dogs ride around in station wagons. Others accompany foot patrolmen—particularly in the town's tough sections. Riders or walkers, they're all trained to perform the same basic functions. Among them:

Control of crowds. In the past few years, Ocean City, Md., has come to expect an annual Labor Day teen-age riot. Kids hit the beaches by the thousands. In one last fling before school they fight, break windows, throw bottles, raise general havoc. With the teen-agers getting completely out of hand last year, the Ocean City police asked help from Baltimore's K-9 Corps.

The teams arrived in the midst of a giant, block-long beach fight. "In 10 minutes the beach was cleared," said Captain Gaeng. "We didn't have to do a thing—just walk along with the dogs."

I witnessed a similar action in Baltimore, on one of those torrid, sultry August nights that spell trouble. We found it when our K-9 station wagon happened upon a mass barroom fight, spilling onto the street. A dozen people were at it with sticks, beer bottles, fists. We screeched to a stop. The patrolman and his dog waded in. Instant silence. No fighting, no commotion—just the quiet voice of the officer saying, "All right, move along now." They did.

Holding. Here's a typical foot patrolman's problem: He catches a couple of guys breaking into a store, searches them, has them lean with hands outstretched against a wall or parked truck as he calls the station house. With a dog, there's no problem. One command—"Watch 'em, boy"—is all that's needed. The shepherd stands guard while his boss calls for a paddy wagon.

Disarming. When a crazed killer comes with pistol flaming at a K-9 cop, the officer merely says to his dog, "Get 'em." He will. If an officer is attacked, the dog will act without orders—the only time he does so.

Searching. A short time ago, a warehouse guard called Baltimore police headquarters to report seeing a flashlight beam in one of his buildings. Po-



Up a fire-escape ladder goes this K-9 trainee, hot on the scent of a criminal who has tried to get away by hiding inside a building.

lice came, searched for an hour, failed to find a trace of the would-be burglar. They had almost decided to call it quits when a dog was brought in. Ten minutes later he was barking and growling in front of a locked door blocked by a heavy box; the suspect was behind the door. He had balanced the box so that



To each dog his master—the only one he'll obey when on duty. Man at far right wears thickly

padded clothes to take the bite out of canine captures during the training course.



Training is a rugged 14 weeks for both officer and animal. In the photo above, several canine-cop cadets go doggedly through their paces.



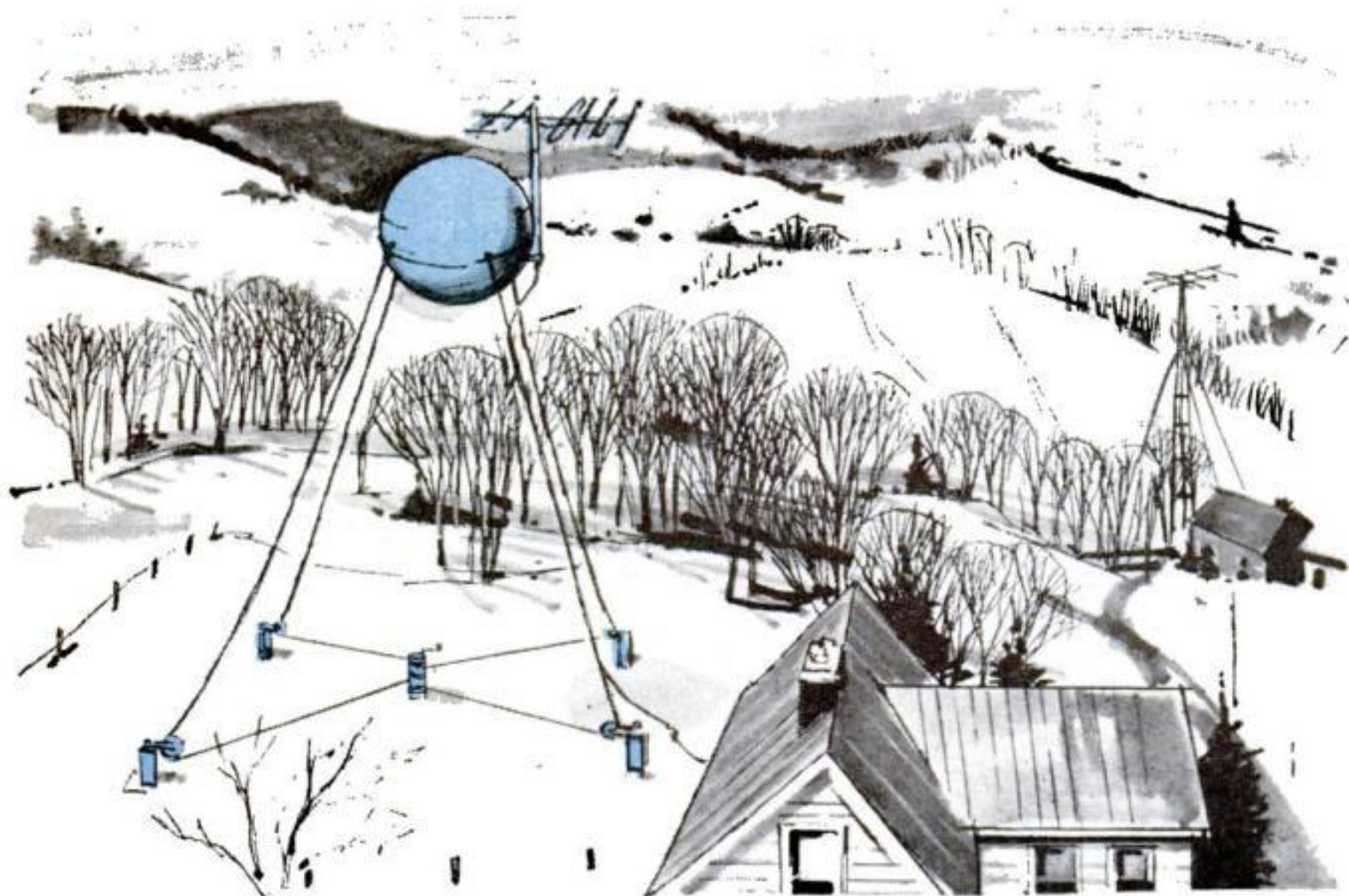
Tricks of the trade are learned at school. Here a German shepherd dog, following a scent, leaps on the back of a man to get onto a roof.

it fell in front when he closed the door, then locked himself in with an inside bolt. At least three policemen had tried the door, found it locked, noted the obstruction, and walked on.

How did the dog find him? Partly scent, partly hearing, and probably, according to handlers, some sixth sense—

perhaps the ability to detect fear. At any rate, it works. Says Washington, D.C., Capt. Frank Breazeale, now supervising the city's 50 police dogs: "To the best of our knowledge, there has been no case where a criminal was hiding in a building and the dogs failed to find him."

[\[Continued on page 186\]](#)

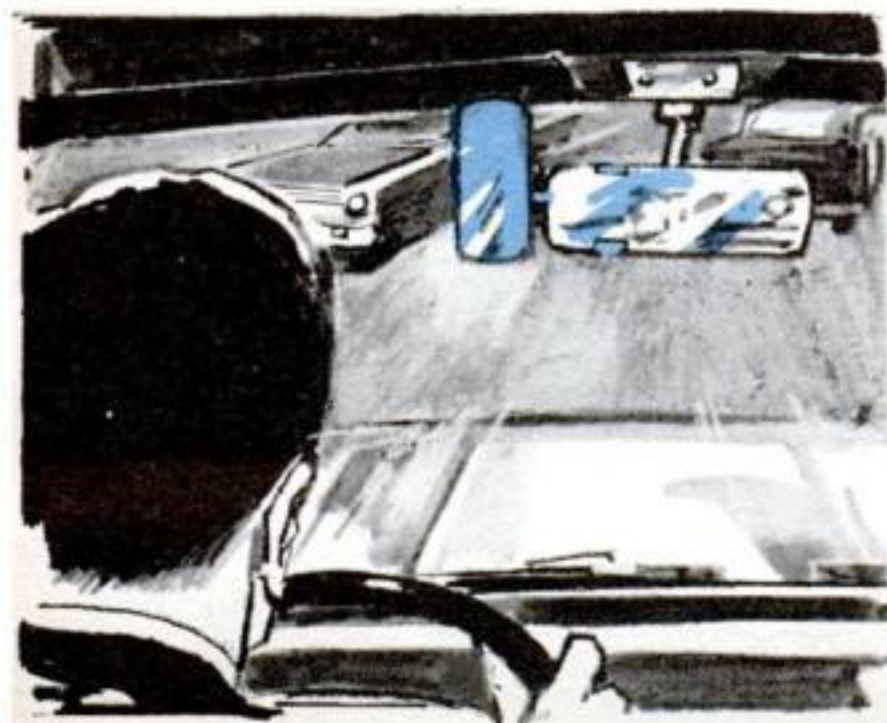


Balloon raises antenna. TV reception in signal-shaded hollows might be improved by this recently patented "tower." The antenna-supporting balloon, inflated with

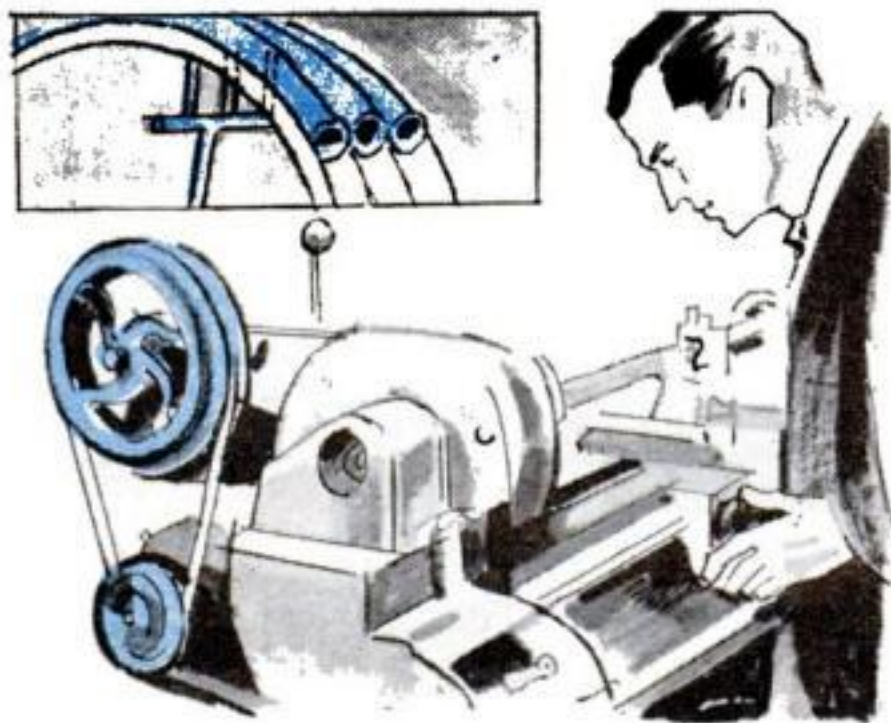
buoyant gas, would float on pulleyed guy ropes. It could rise higher than a costly fixed mast and be cranked down for maintenance or protection from storms.

New ideas from the inventors

Clip-on mirror widens view. Hooked to the side of a standard rear-view mirror, this ball-jointed auxiliary mirror could be angled to extend a driver's lateral view. It might make turnpike driving safer by reflecting adjoining-lane cars that are normally hidden from sight and clue you in for passing.



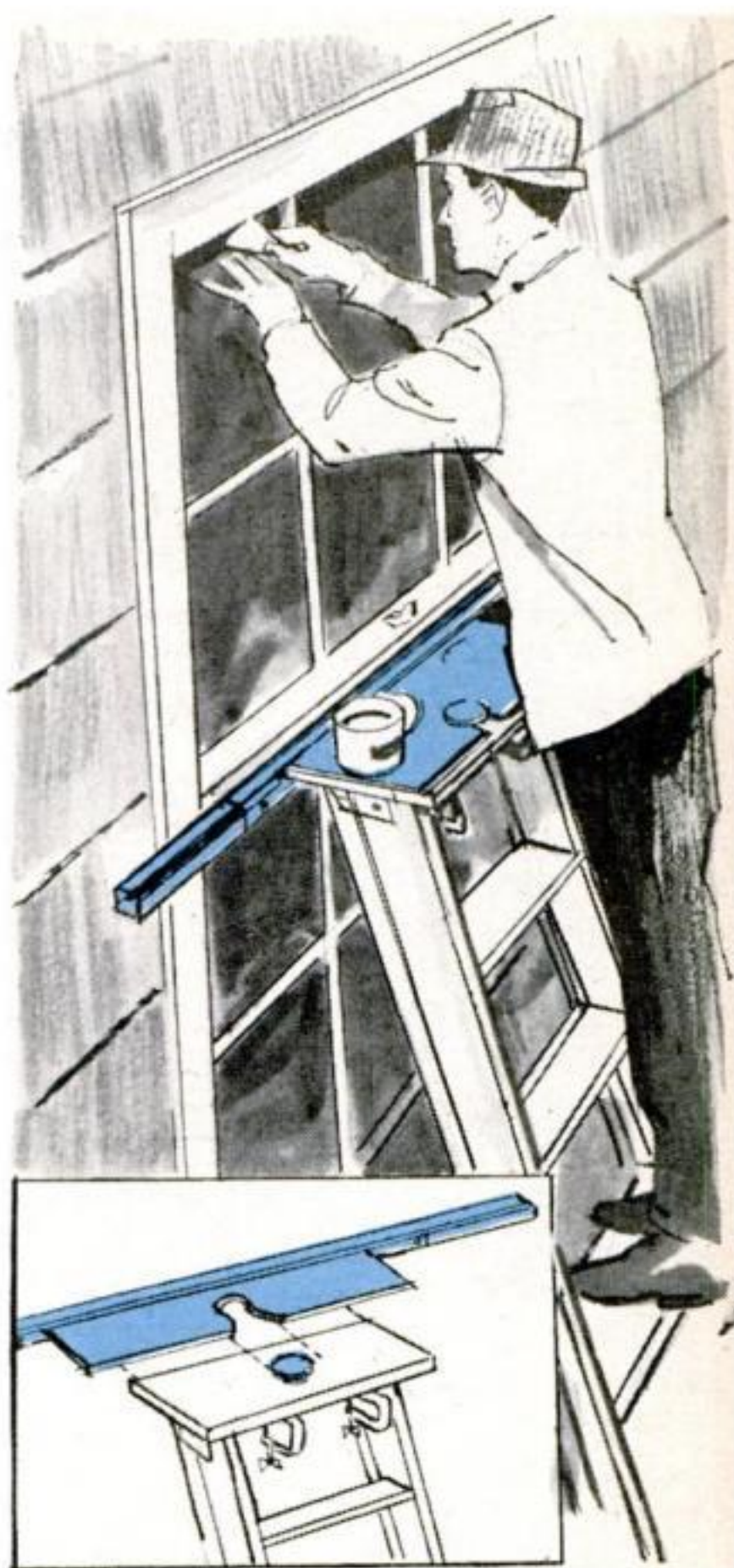
Inflatable pulley varies speed. Expanded (or contracted) by fluid pressure, pneumatic tubes in the rim of this pulley would change the drive ratio between the motor and shaft of a tool or vehicle. The speed-controlling pump would be coupled to the tubes through the pulley shaft.





Vented form presses shirt. Forced through small holes in this torso-shaped plastic form, jets of warm air would dry and press a damp shirt quickly and smoothly. Clip-on stiffening rods would align front folds and hold up the collar during pressing. Electric coils and a small blower in the base would provide the heated air.

Vibrators to keep you awake. A driver who had shaker-uppers installed in his car seat could guard against fatigue accidents by switching them on when he felt drowsy, says one inventor. Eccentrically weighted shafts on small electric motors would deliver sudden and irregular jabs to dispel sleep and keep the driver alert.



Tool tray braces ladder. Leaning out into space to work can be hazardous. By bridging the sides of a window, these extension bars would let you place a stepladder parallel to your work and give steadier purchase on an uneven surface. The bars would extend from a tool-holding tray cut and beveled for a nonslip swivel fit around a stud clamped to the ladder platform.

The following patents have been issued on these inventions: Antenna—No. 3,045,952 to L. E. Underwood, Hayward, Calif.; Mirror—No. 3,048,084 to H. J. Iannuzzi, 53 Frederick Ave., Medford, Mass.; Pulley—No. 3,048,048 to L. P. Weston, Gibbon, Neb.; Presser—No. 3,048,310 to M. R. Dosal, P.O. Box 53-62, Miami Shores, Fla.; Vibrator—No. 3,037,499 to John Cummins, Inwood, N.Y.; Ladder tray—No. 3,042,142 to C. L. Butler, Eustis, Fla.

Copies of patents may be ordered, by number, from the Commissioner of Patents, Washington 25, D.C., at 25 cents each. To write to an inventor, if the address given above is insufficient, address him (by name and patent number) in care of the Commissioner of Patents.

Are We Winning the 'Cold' War?

Yes, say the experts. Some day you may be able to breathe a vaccine against sniffles—and prevent cancer, too

By Joan Steen

EVERY time you catch a cold, you catch a different disease. Or at least a disease you haven't had for a while.

The same goes for flu. If you come down with it twice this winter, the chances are it will be Asian flu the first time (it's at the peak of its two-year cycle). The second time you might just as well consider it a new disease. It'll be a different kind of flu.

If you were in the service did you suffer a miserable ache-and-fever infection during the first few weeks? Maybe it seemed like flu or a bad cold, but this, too, was a different disease: "adenovirus infection." Basic-training camps are often loaded with it, but—surprisingly—it rarely affects adults elsewhere.

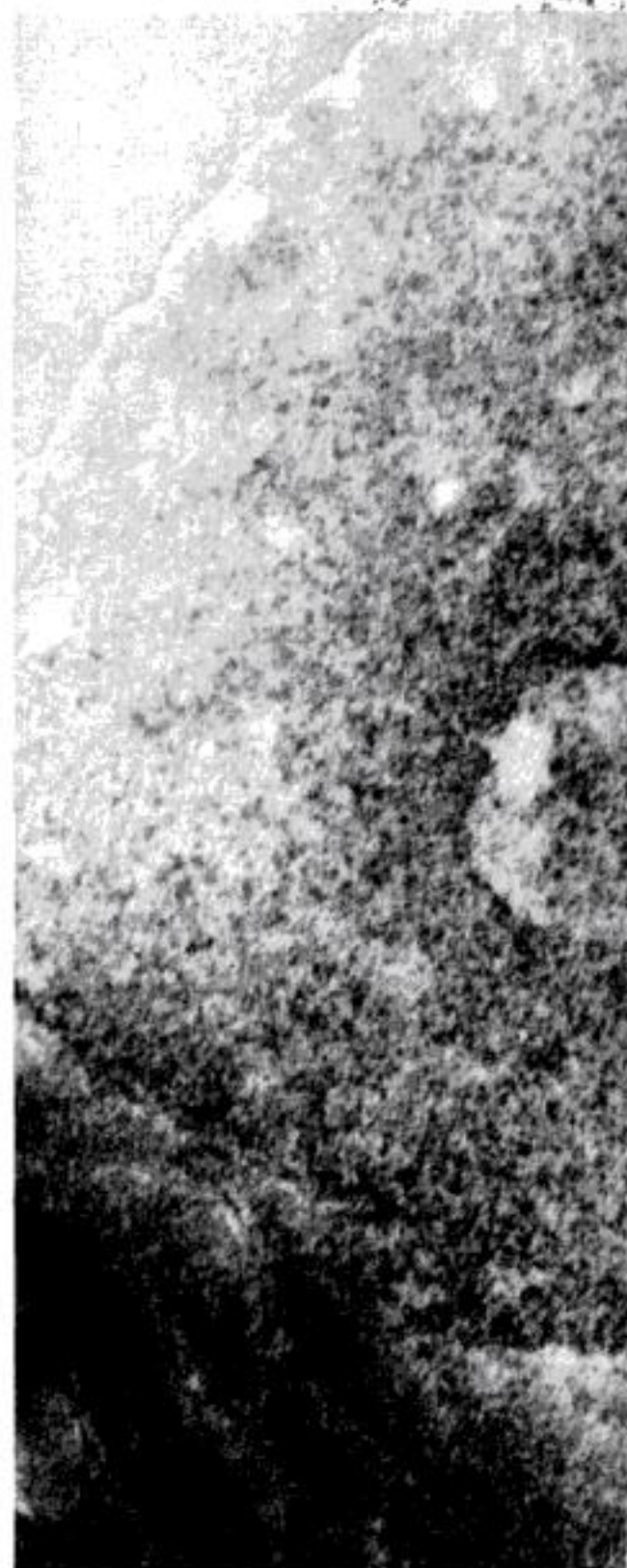
These examples are typical of the clues scientists have been picking up in the last few years as they track down the causes of what now appear to be a variety of "colds," "flus," and "pneumonias." Man's vital airways—the paths from nostrils to lungs, or from mouth to stomach—are hosts to a vast zoo of parasites.

The invaders account for perhaps half a *billion* respiratory sicknesses in America every year, or, in one estimate, half of all illnesses put together.

Some of the "bugs" are bacteria. But over 90 percent of the zoo represent the smallest, most fiendishly adaptive, most baffling organisms known to man: the viruses. What do scientists now know about them? Here, in question-and-answer form, are some of the answers:

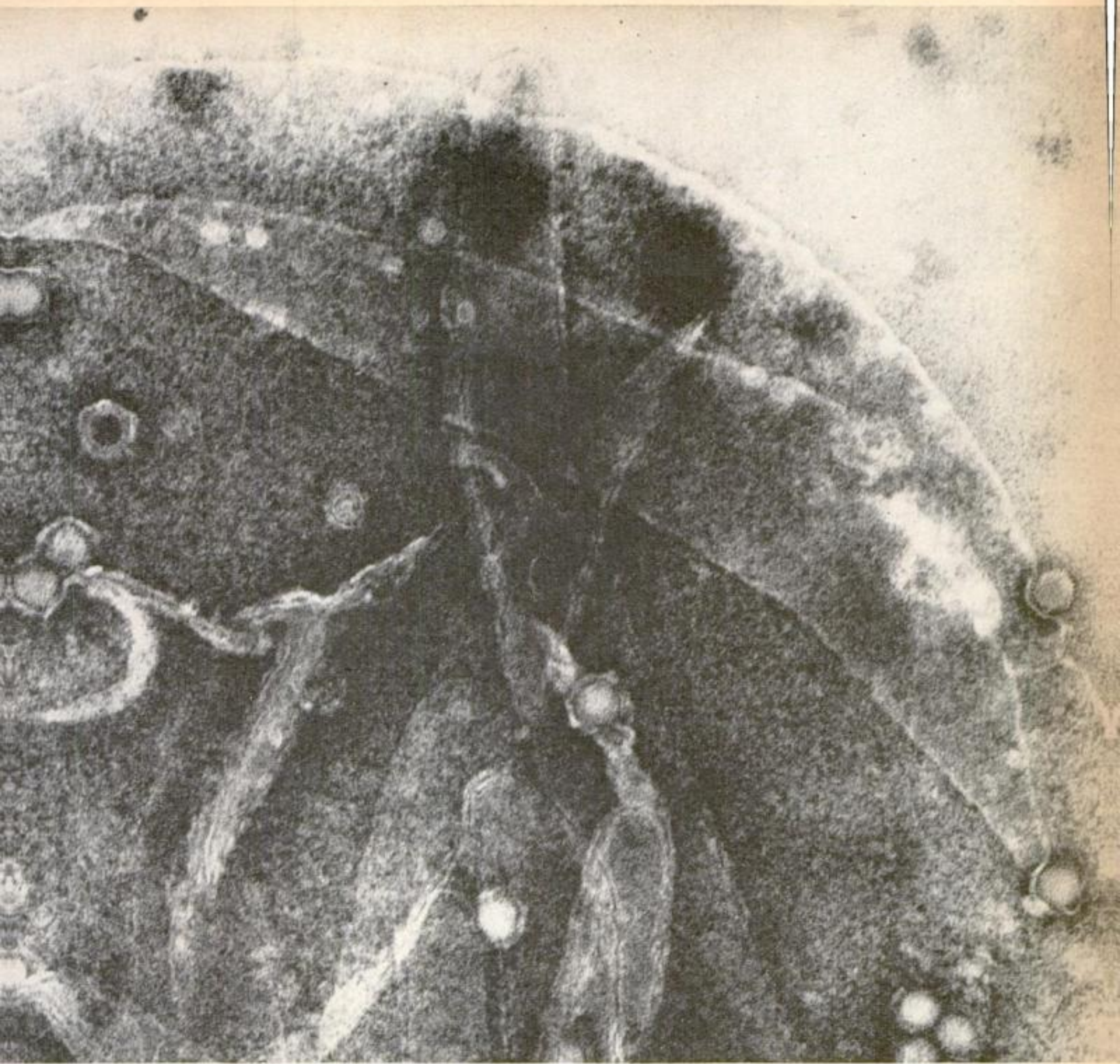
First, what is a virus?

Picture a sphere so small that 50 billion of them could fit on a postage stamp. Now take a closer look. The sphere is really made up of 20 triangular-shaped sides—like a gem. Each triangle in turn is packed with even tinier spheres—like a gem spread with caviar. That's what one

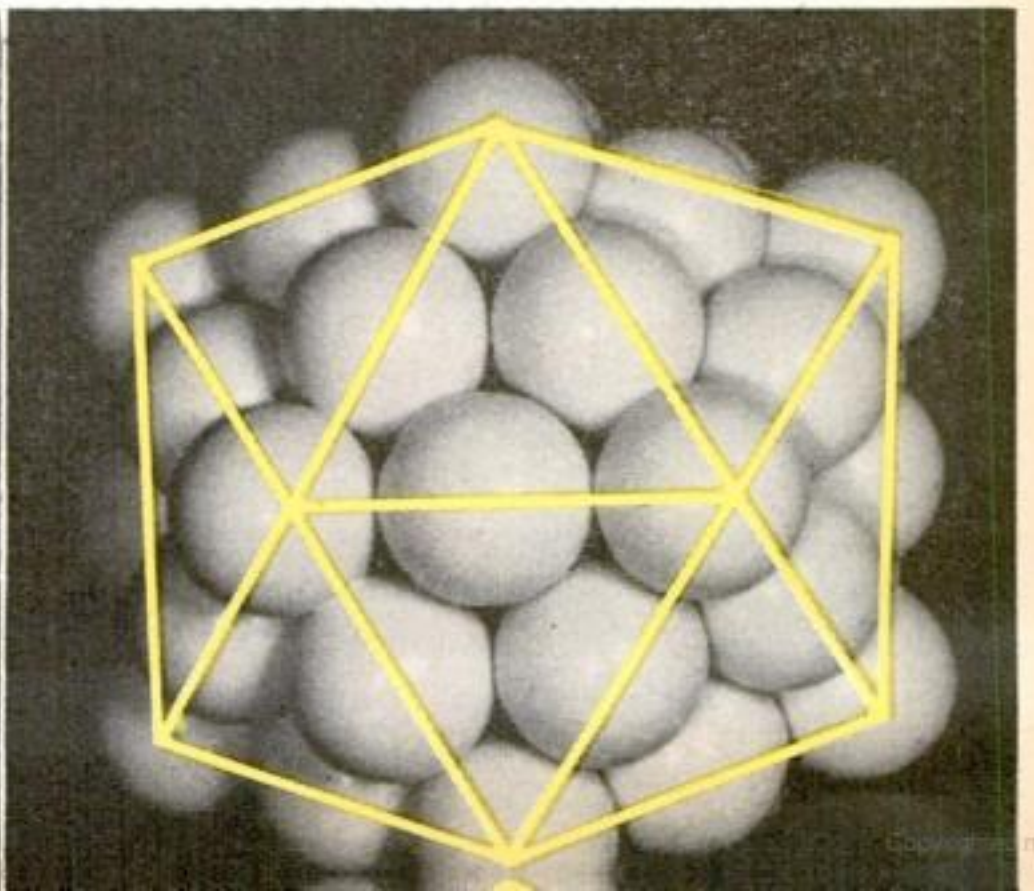
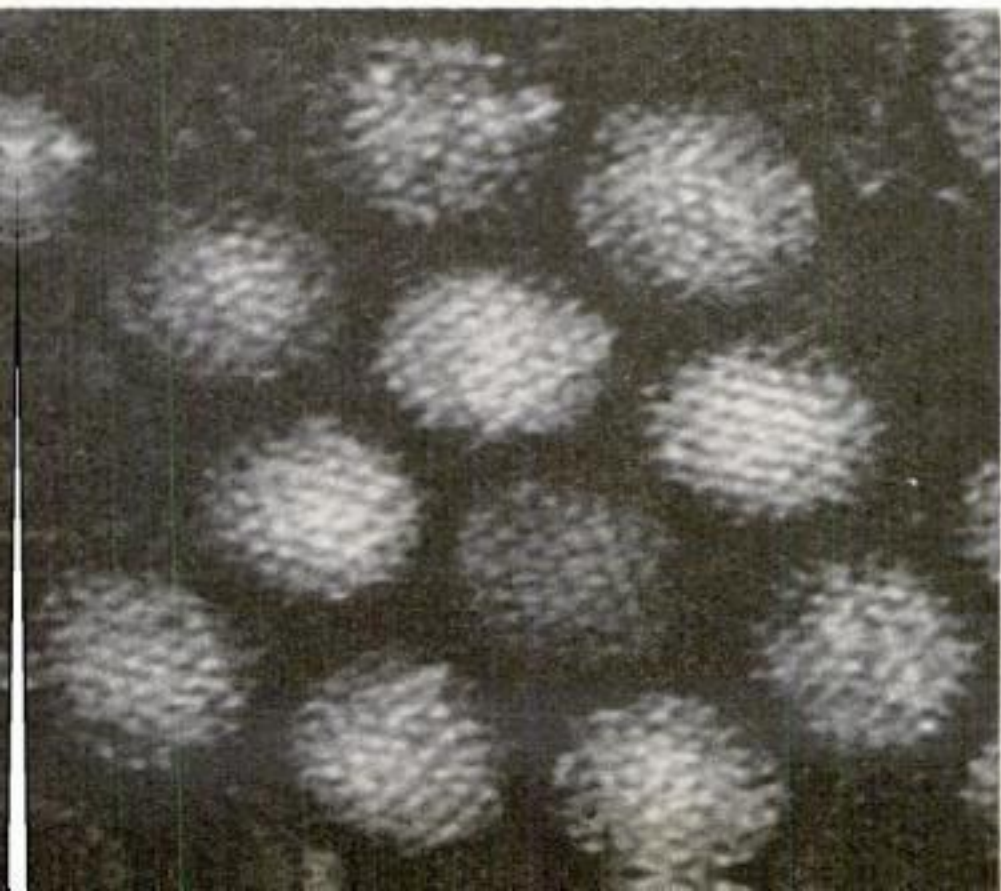


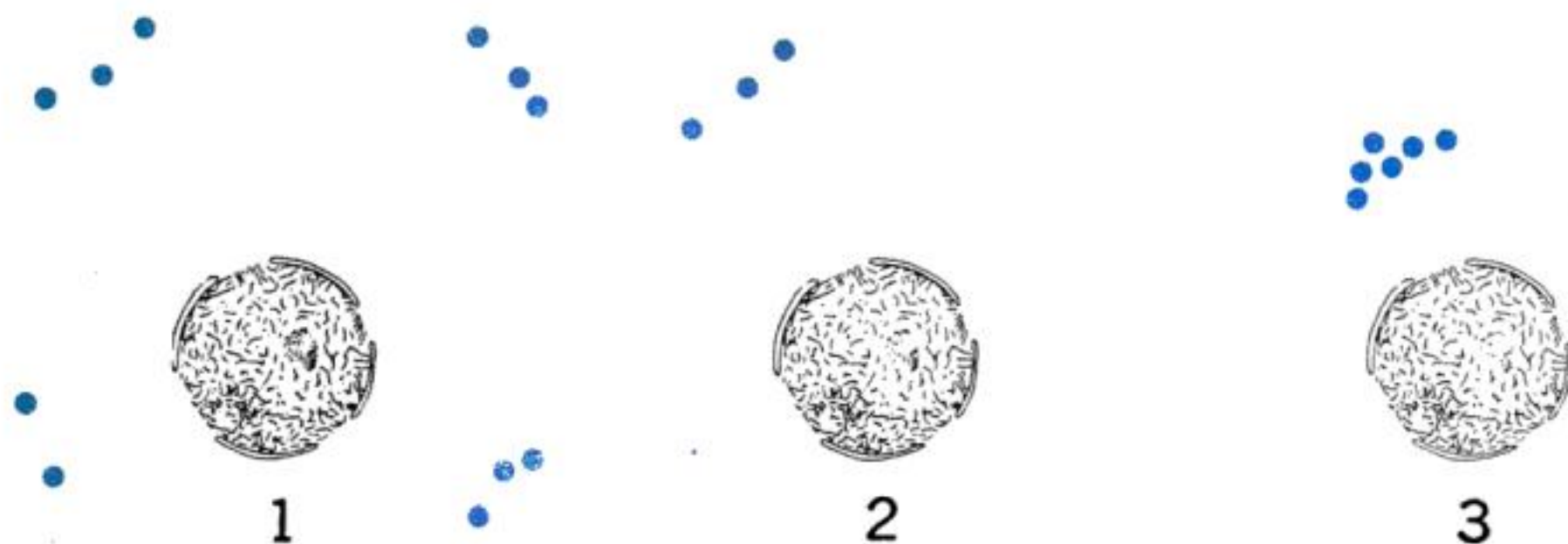
Like snowballs hitting the

What do viruses look like? Some are ovals; some are rod or twisted-column shapes; but others are perfect gems like the adenoviruses shown above and clustered at the right in electron-microscope pictures taken by Dr. Samuel Dales of the Rockefeller Institute. These viruses look like 20-sided figures called icosahedrons. Each side is a triangle stacked with proteins that fit together in the 1-2-3 arrays suggested by the model at the far right made by Dr. Heather Mayor of Baylor University. The balls are protein chains.



moon, adenoviruses spot surface of a human cell. The next step is getting in.





How scientists think one type of "cold" virus infects a cell

Adenoviruses surround a cell and make contact in several places (1). The cell engulfs the particles, enclosing them in bubble-like struc-

tures called vesicles (2). As more and more viruses enter the cell, the vesicles come together to form "islands," which migrate toward

of the newer viruses—adenovirus—looks like through an electron microscope.

The tiny spheres represent protein molecules that fit together to form the virus' "coat." Inside, coiled up like threads, are molecules of acid, either DNA—deoxyribonucleic acid—or RNA—ribonucleic acid, a close relative.

All viruses have those two ingredients in common: the protein coat and the acid core. But the ways of putting them together lead to hundreds of shapes and sizes of viruses capable of causing disease in all forms of life from bacteria to man.

Are viruses themselves alive?

The old answer was no. Viruses were thought to be chemicals that were inactive except when they were inside a living cell. Then, in some robotlike way, they took over the cell's machinery and got it to mass-produce new virus particles.

But today most virologists think viruses *are* alive. They could be degenerate forms of disease-causing bacteria, stripped down so that they contain only one of the two acids that scientists now believe determine the structure of all living things: DNA and RNA. That would explain why viruses can't reproduce by themselves, but need the help of a living cell. In the course of this, they "evolve" from generation to gen-

eration, developing ever-new strains.

In any case, most specialists feel that viruses are too adept at survival to be considered "mere molecules."

Are they really so tough?

Yes. You've had proof if you've ever gone to the doctor with a virus disease. He says, "Go home and go to bed. There's nothing I can do." Except for one particular virus disease, there are no drugs yet that kill viruses once they've infected you—without hurting you.

What about vaccines? Don't they prevent infection?

"Prevent" is the word. Vaccines give you a mild dose of disease so that your body can learn how to fight back. Vaccines may contain killed virus (you *can* kill virus in a test tube with formaldehyde) or live virus weakened by being grown in other animals or in specialized cell lines cultivated in the lab.

How does the body fight a virus infection?

One way is by producing antibodies. The body makes these complex protein molecules to meet many kinds of foreign invaders. In the case of virus attack, the antibody fits the surface of the virus particle in some way and blocks its ability to take over the cell.

But the virus-antibody reaction is ex-



4



5



6

the nucleus (3 and 4). Finally the islands break up and the viruses enter the nucleus. At this stage they go into an "eclipse" and can no longer be seen (5). Then, gradually, new viruses appear. Because of their symmetry the

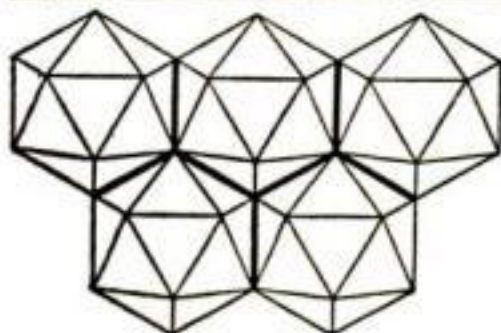
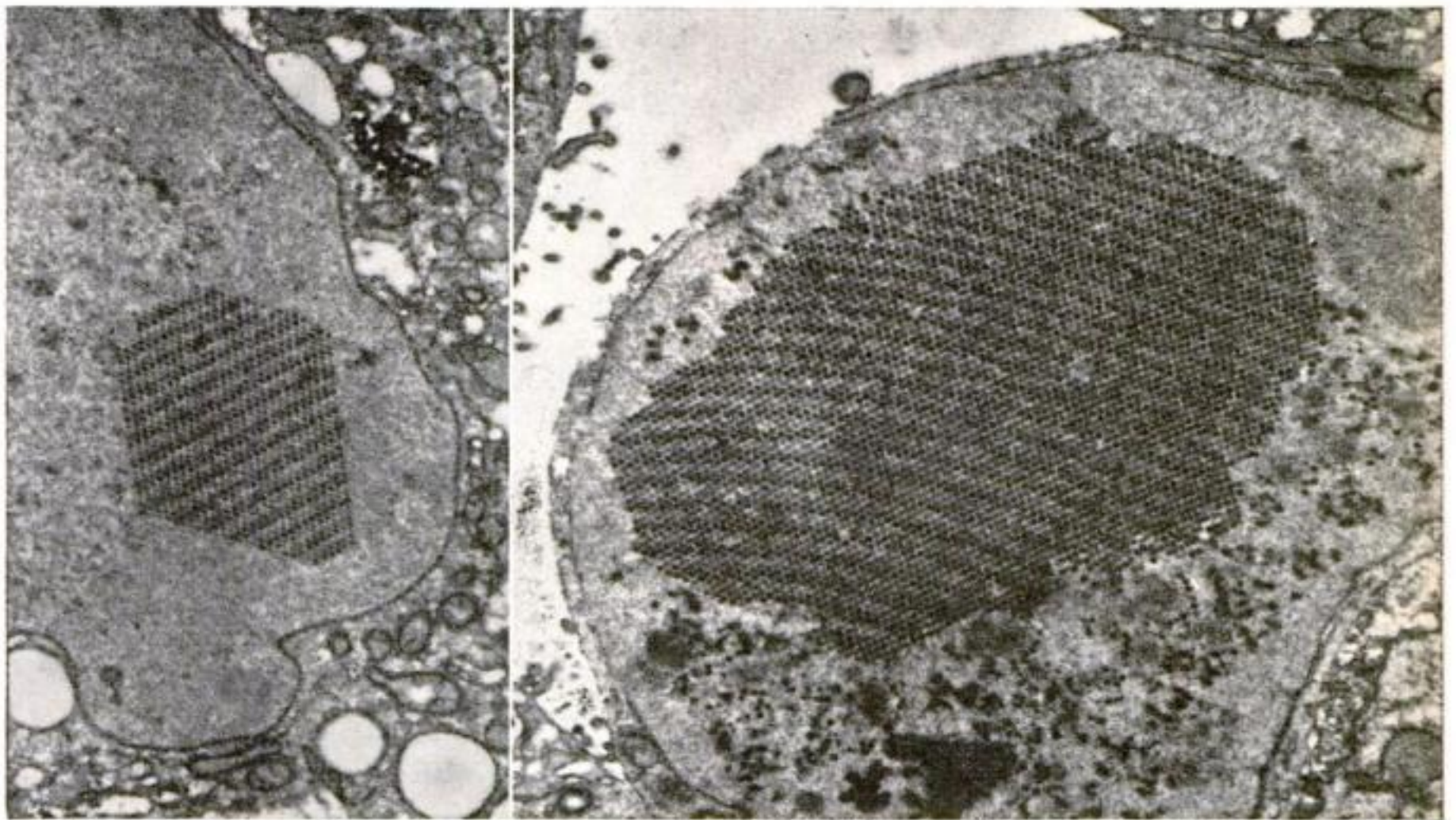
particles clump together like cells in a honeycomb (6). Eventually the nucleus is overwhelmed. It breaks, the viruses escape, and the cell dies. For slow-growing adenoviruses the cycle may take up to two weeks.

tremely specific. That's why you hear so much about types of virus: influenza "A," or "B," or "C," and strains within types: "A1," "A2," etc.

That's also why your second cold is different from your first. Your body learned how to cope with the first cold virus and it will remember this for sev-

eral months. You have a temporary immunity. But your body is not prepared to stave off infection from a second breed of cold virus.

For the same reason, the shot you get to prevent influenza A2 (Asian flu) won't help you fight influenza B. The antibodies needed are different.



How a cold digs in is sketched in at the top of the page, but these photographs are *real*. Made by Dr. Councilman Morgan of Columbia University, they show how newly formed adenovirus particles in nucleus (bounded gray area) pack into crystals. An early stage is shown above at left. At right, nucleus has nearly filled and some viruses have become detached from the crystal mass. The virus's shape is well suited to stacking, as diagram (left) shows. Each adenovirus particle is about .000004 inch in diameter or smaller.



Influenza viruses are rounded shapes with dark centers where the virus acid lies. These flu viruses are being released from a section of the surface membrane of a chick-embryo cell.



ECHO virus above is one of a group of viruses "in search of a disease." The viruses, growing in a monkey cell, line up like kernels of corn in this study by Dr. Richard Rifkind.

But can't you put a lot of different types of virus in one vaccine?

Yes, to some extent. And when a vaccine against the common cold is produced, it will probably be a multiple ingredient one.

Just how many kinds of colds are there?

Brace yourself. Techniques have improved so in the last few years that scientists have now been able to isolate about 150 different viruses associated with runny noses and sore throats.

Some of them are more potent viruses like flu or polio or the adenoviruses which, in mild cases, produce coldlike symptoms. Others are mild virus groups known under such names as "muriviruses" (mild upper respiratory illness); "rhinoviruses" (nose viruses); and "coryzaviruses" (runny-nose viruses).

Are any of these mild groups related?

Yes. The viruses all seem to be small; they contain RNA; and, although they were isolated exclusively from nose and throat areas of patients, they show certain similarities to viruses usually found in the intestine, like polio or the ECHO viruses found a few years ago. Unfortunately the cold viruses are distinct in

terms of the antibody-building reaction.

Then a common cold vaccine might have to contain 150 kinds of virus?

Probably not. A vaccine like that would be impractical—and possibly dangerous to your health.

Is there any hope for a vaccine?

Yes, a great deal. The virus population explosion has spurred rather than discouraged research. At a fall meeting sponsored by the University of Southern California at the National Institutes of Health in Bethesda, Md., over 500 virology specialists met to pool their latest findings. The news is exciting.

Some vaccines have already been made to handle new viruses—notably the adenoviruses.

Second, vaccines to come may be administered in new ways with more potent results.

You mean I won't have to have a shot in the arm?

That's a possibility. You may be able to *breathe* vaccines in the future. Dr. Vernon Knight of the National Institute of Allergy and Infectious Diseases, and other researchers in the country, have

[\[Continued on page 188\]](#)



Retractable chains fold back from tire

Snow grippers attached to the drive wheels can be folded back against the hub when the road is clear, and repositioned without fuss when needed again.

Hinged arms, held flat against a circular plate in the off position, are released by pulling a pin in each. Their flat-chain ends are tensioned to hug the tire tread.

The Swiss maker tested them on a front-drive Citroen, says he did 80 m.p.h.

Automotive jack ramps

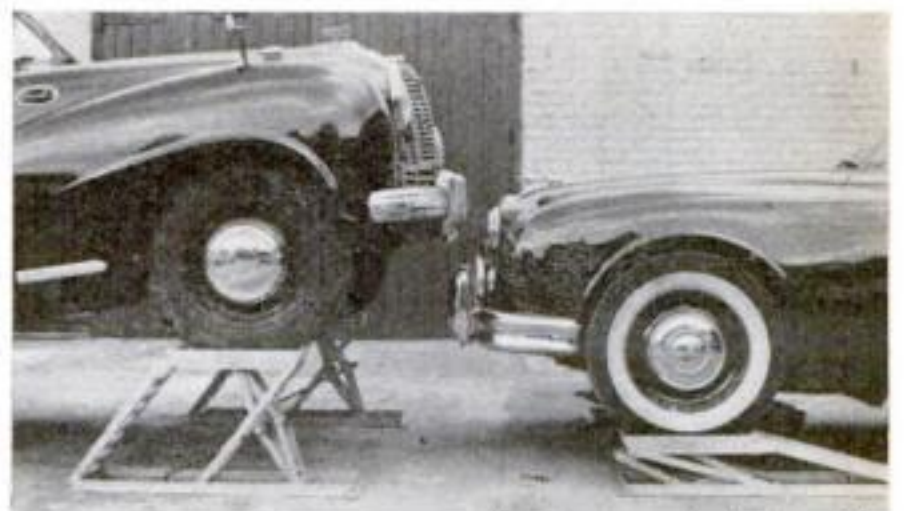
British-made wheel ramps with built-in jacks give easy access to a car's undercarriage. They flatten to a height of 6½ inches. A stop plate keeps you from driving too far, and a slip-in securing pin on the approach side prevents rolling back. Once the wheels are in place, ramps on the two sides are cranked up alternately, a few turns at a time.



Magnetic boot finds lost skier

A fast, reliable method of locating a skier buried under a snow avalanche has been developed by the Swiss army and a California company. The system uses a portable magnetometer—an instrument for measuring the intensity and direction of magnetic forces—and a magnet carried in the skier's clothing.

The lightweight detector, made by Varian Associates, Palo Alto, is so sensitive it can locate a cigarette-size magnet built into the heel of a ski boot and buried, as shown here, in snow several feet deep.



Big Bang from Little

A strange breed of tiny souped-up .22s is sparking a wild and wacky

By Phil McCafferty

BELIEVE it or not, both of the cartridges you see below are the same caliber. Both are .22s. The one on the right is the familiar little .22 Short, a favorite of back-yard plinkers for years. The huge shell on the left has a bullet of exactly the same diameter.

But there resemblance ends. The giant cartridge is one of a growing breed of superpowerful .22s so fiercely awesome that:

- They'll put five shots in a target 100 yards away and make a single hole small enough to cover with the tip of your finger. At 200 yards—twice the length of a football field—you can cover a similar five-shot group with a penny.

- They'll reach phenomenal muzzle velocities of up to four-fifths of a mile a second—nearly 3,000 miles an hour—and slam a target with a half-ton of explosive force.

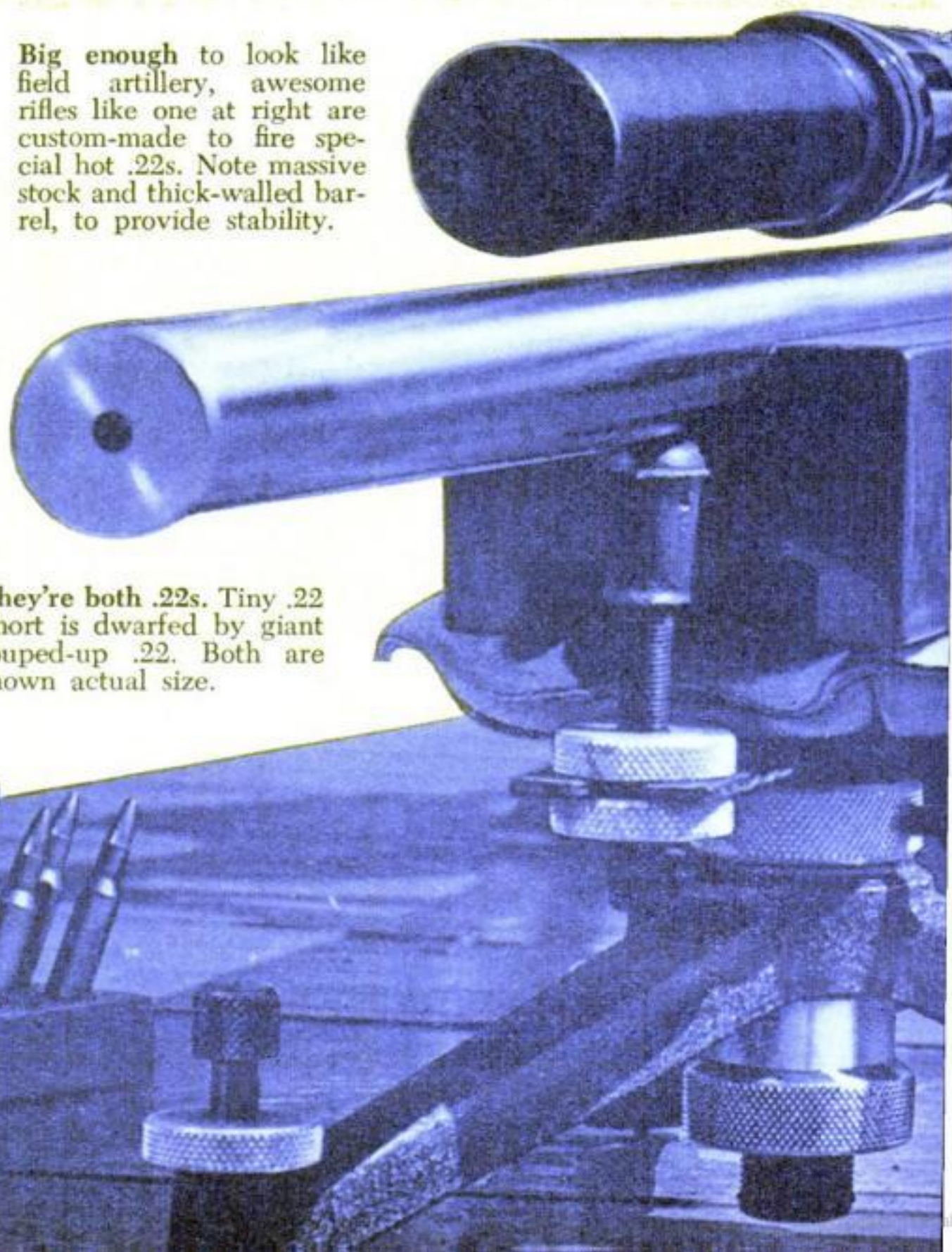
- They'll punch clean-cut holes in half-inch steel plate while ordinary .22s

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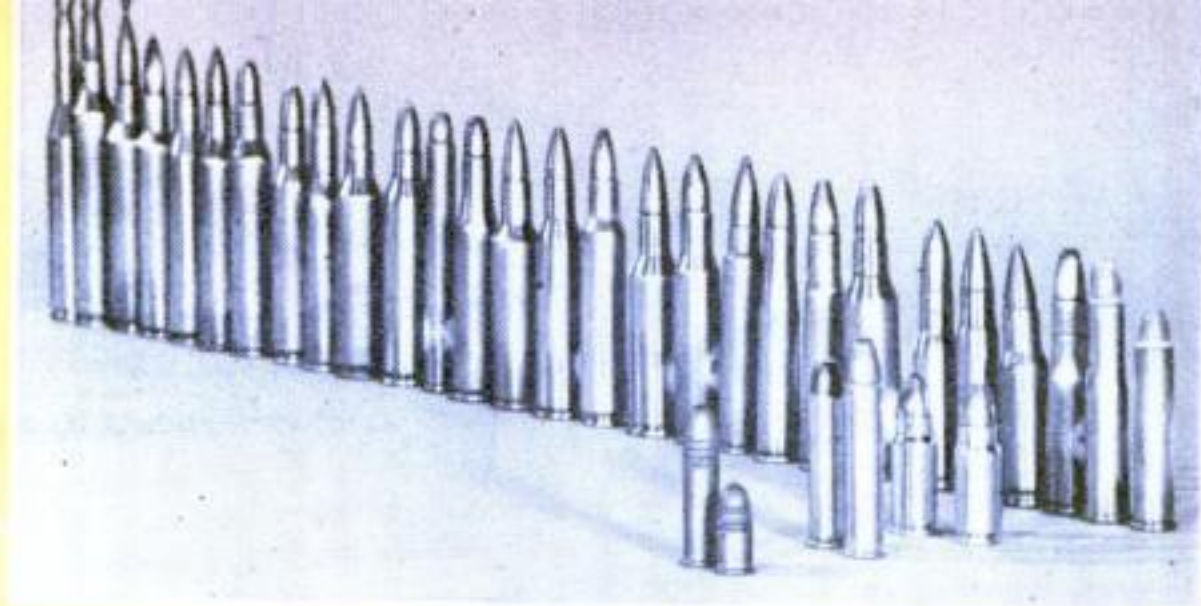
Big enough to look like field artillery, awesome rifles like one at right are custom-made to fire special hot .22s. Note massive stock and thick-walled barrel, to provide stability.

They're both .22s. Tiny .22 Short is dwarfed by giant souped-up .22. Both are shown actual size.

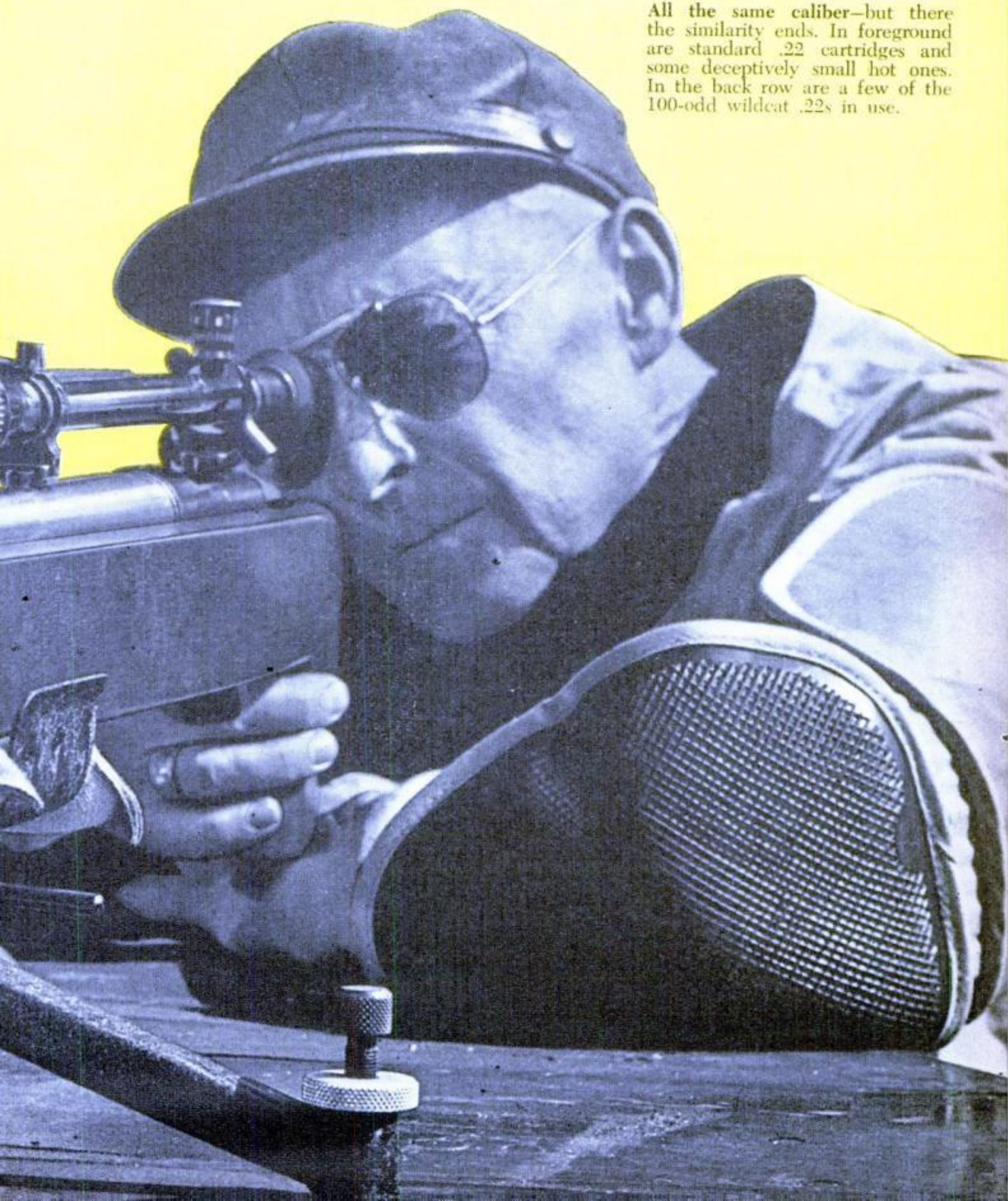


Bullets

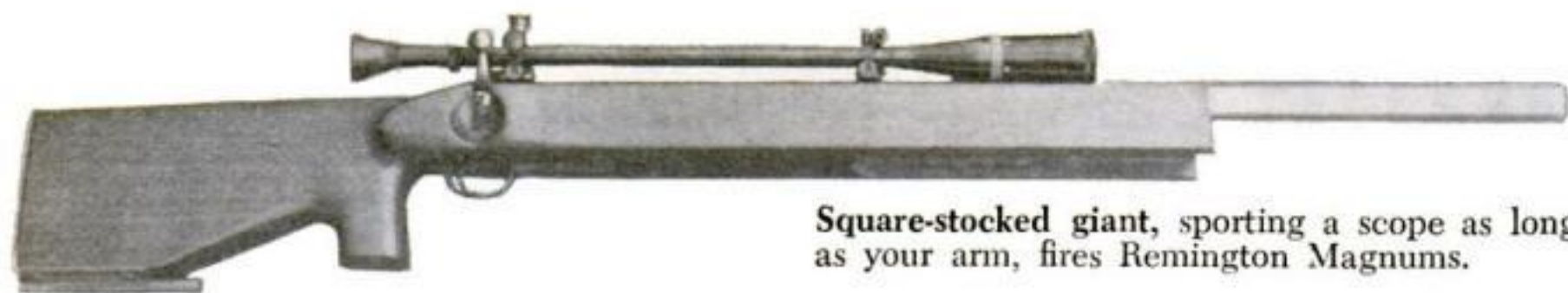
sport for gun buffs



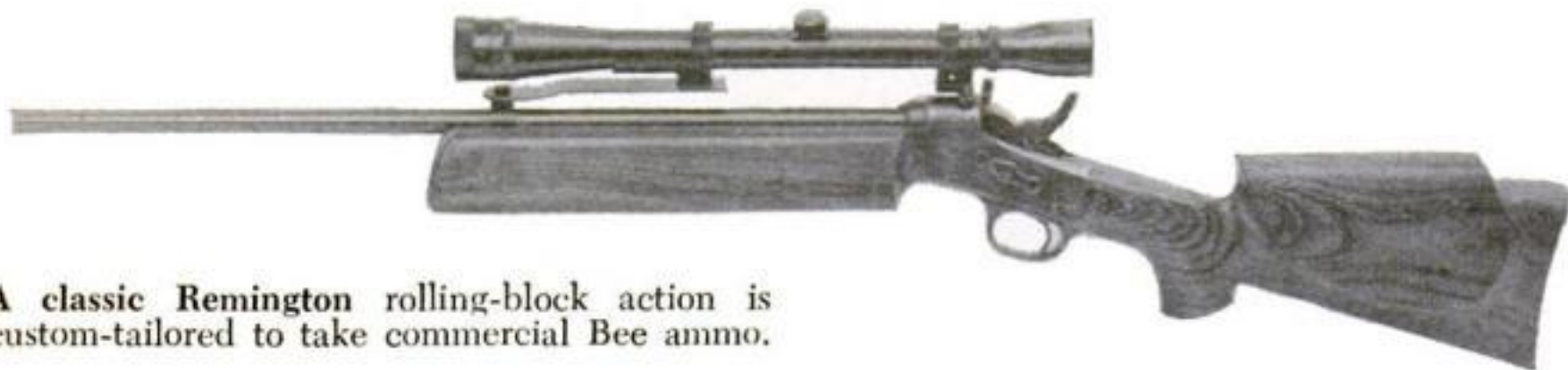
All the same caliber—but there the similarity ends. In foreground are standard .22 cartridges and some deceptively small hot ones. In the back row are a few of the 100-odd wildcat .22s in use.



"Hot" guns are as weird and wonderful as the ammo they shoot



Square-stocked giant, sporting a scope as long as your arm, fires Remington Magnums.



A classic Remington rolling-block action is custom-tailored to take commercial Bee ammo.

splatter off like raindrops on a window.

Such souped-up missiles are about as similar to the ordinary little .22s as a big-game rifle is to a bean shooter. Most of them are as fast or faster than the .30-30s, .30-06s, and other large-caliber ammunition used in military and hunting rifles. Some, in fact, are actually original .30-30 or .30-06 shell casings necked down to take the smaller .22-size slug. The result is a bullet propelled by enough powder to fill a dozen conventional .22s.

Who shoots them? With power like this, it's easy to see why the hotted-up .22s hit the bull's-eye of popular fancy. Farmers seeking to rid their lands of varmints have found a new weapon that turns near-misses into sure hits at unbelievable ranges. The bullets strike with such force that even a badly placed shot disintegrates a target no matter where it hits.

Target shooters have also latched onto the precision accuracy of the super .22s. Within the past few years, two major ammunition makers, Remington and Winchester, have come out with new models of the hot .22. One, Remington's .222 Magnum, is a wickedly lethal two-inch-long cartridge that looks as if it could down an elephant—and actually could (an earlier .22 similar in size did).

The second newcomer, Winchester's .22 Magnum Rim Fire, is a more mod-

est version that looks like a slightly stretched-out standard .22 Long Rifle cartridge. Its velocity is also stretched—from 1,200 feet a second to a sizzling 2,000.

Another recent development is a deceptively small, squat, snub-nosed Canadian cartridge called the JGR. It's no longer than a regular .22 Long Rifle, but what comes out of the barrel packs twice the speed and wallop of a conventional .22. Remington, eyeing the rise in pistol popularity, has also brought out a hopped-up shell designed especially for handguns. Called the Jet, it has a muzzle velocity of 2,460 feet per second.

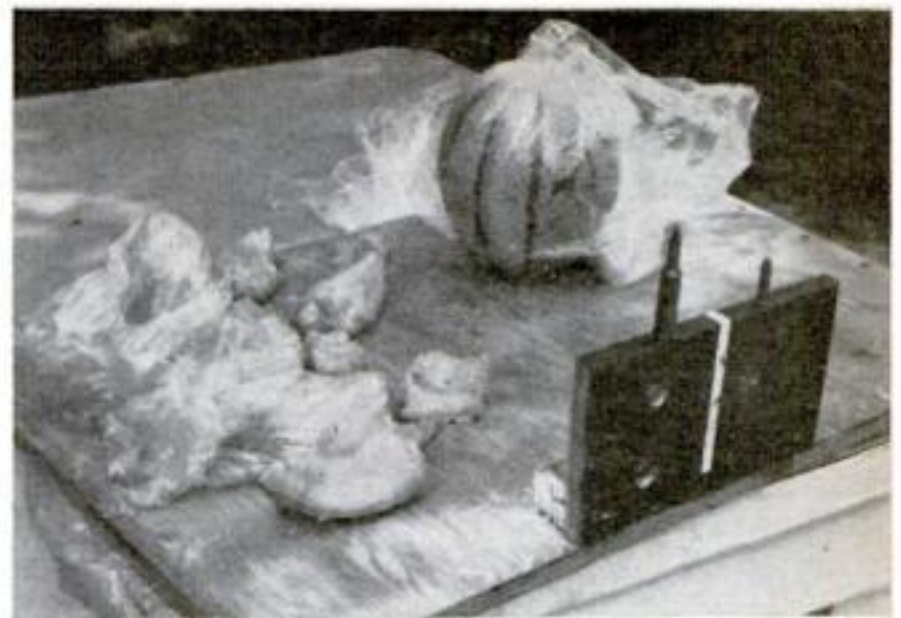
But most of these newcomers are gentle compared to still more powerful cartridges that started the hot-.22 race some years back. They go by such fast-sounding names as Swift, Bee, Zipper, Wasp, and the now-legendary Hornet. These spit out lead at 3,000 to more than 4,000 feet a second—three to four times faster than an ordinary .22.

Of these, the undisputed king is the mammoth .220 Swift, nearly three inches long with a muzzle velocity of 4,110 feet a second. Its trajectory is so flat you can dead-aim a target at 100 yards with almost zero allowance for bullet drop. By comparison, a standard .22 drops about three inches at 100 yards.

Wildcats are even wilder. In addition to these commercially produced hot .22s,



Spray of water is all that's left of gallon jug hit by high-powered Wasp .22 traveling 3,600 feet a second. Bullets literally explode, do not continue flight or ricochet as standard .22s can. Photo was made at 1/400 second—in one try—by giving shooter a countdown.



Explosive force of hot .22 blasts melon at left to bits, while stock .22 merely punctures melon at right. In foreground, ½-inch-thick steel plate is punched clear through on left side by hot .22, but is left unscathed on the right side by conventional .22 that merely splatters off.

there is another whole group of “wildcats” and “mavericks”—home-grown shells painstakingly put together in basement workshops by amateur gunsmiths. Original high-caliber shell casings are stretched, shortened, necked down, blown out, and in other ways reshaped to produce a cartridge that technically takes a .22-size slug but otherwise bears little resemblance to any of its stodgier cousins.

To date, there are more than 100 na-

tionally recognized mavericks. Most commercially produced ammo is considered docile compared with the fiery home-brewed concoctions of these wildcatters.

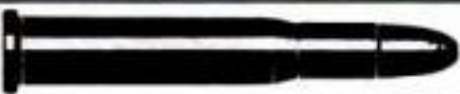







In the hot-.22 race, some experimenters find they have a tiger by the tail. One cartridge of fleeting fame called the Thunderbolt attained the remarkable speed of 5,000 feet a second and prompt-

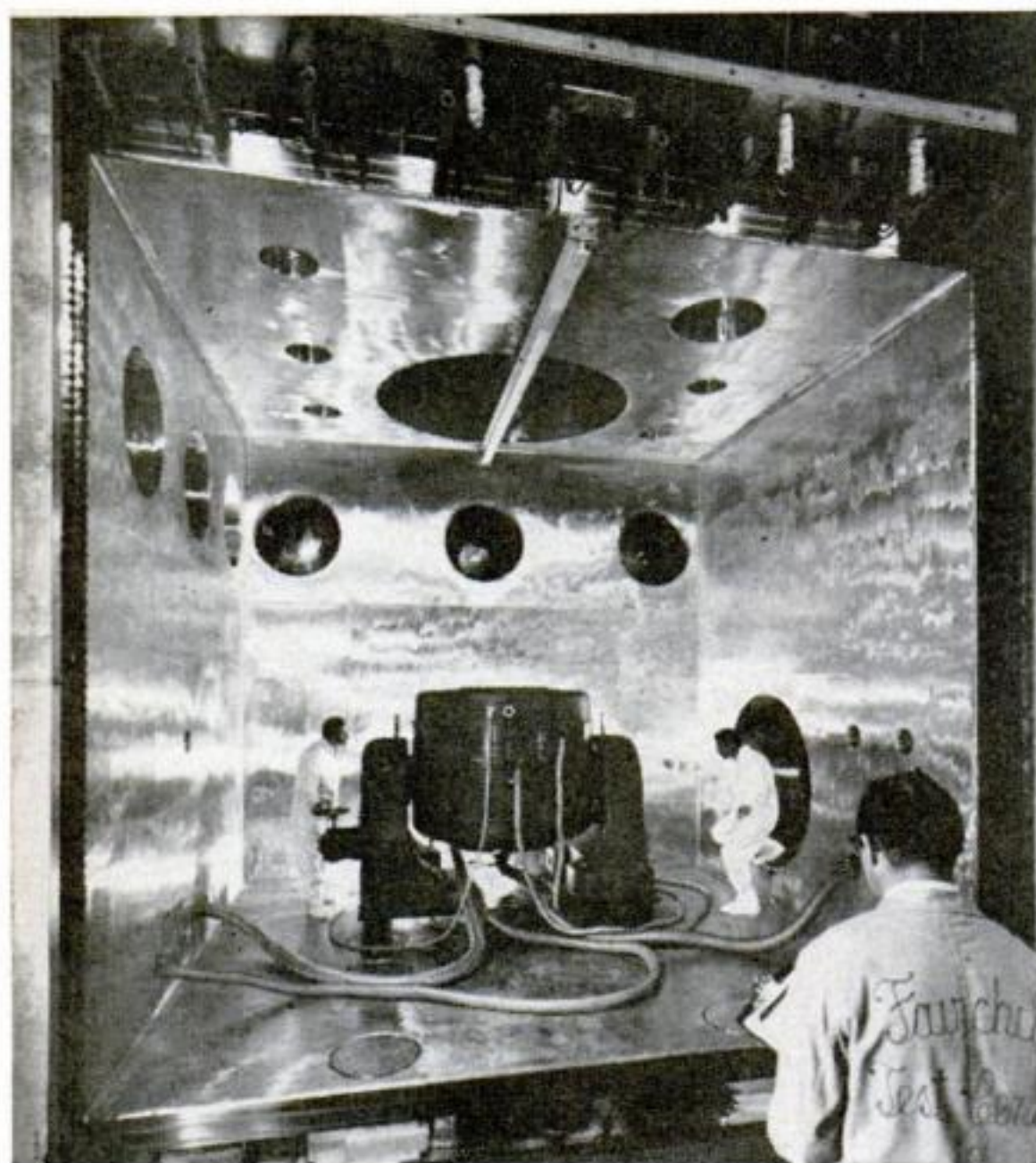
[\[Continued on page 192\]](#)

Why the hot .22s are so deadly

Muzzle velocities are the tip-off. Note that hot .22s far outfire not only conventional .22s, but even the famed big-game .30-30. The Swift,

with a bullet a third the weight of the .30-30, has almost as much striking power—1,300 foot-pounds against the .30-30's 1,360. Other hot .22s, though milder, have two to ten times the striking power of regular .22s.

TYPE OF BULLET	BULLET WEIGHT (in grains)	MUZZLE VELOCITY (ft. per sec.)	STRIKING POWER (foot-pounds at 100 yards)
 .30-30	150	2,410	1,360
 .220 SWIFT	48	4,110	1,300
 .219 ZIPPER	56	3,110	740
 .222 REMINGTON	50	3,200	785
 .22 HORNET	45	2,690	410
 .22 WINCHESTER MAGNUM	40	2,000	170
 .22 LONG RIFLE	40	1,145	84
 .22 SHORT	29	1,125	54



Shake-up tests for spacecraft instruments

A 15-ton vibrator is shown here being installed in a stainless-steel chamber, part of a new \$2,000,000 space-environment laboratory. Fairchild Camera and Instrument Corp. will use it to test cameras and other sensing devices in simulated altitudes up to 380 miles.

The huge shaker was moved into the chamber on an overhead gantry before the fourth wall was put up. The hole above it provides room for tall devices. Others in the walls are for vacuum-regulating pumps.



Cat photography—on a coal pile at night

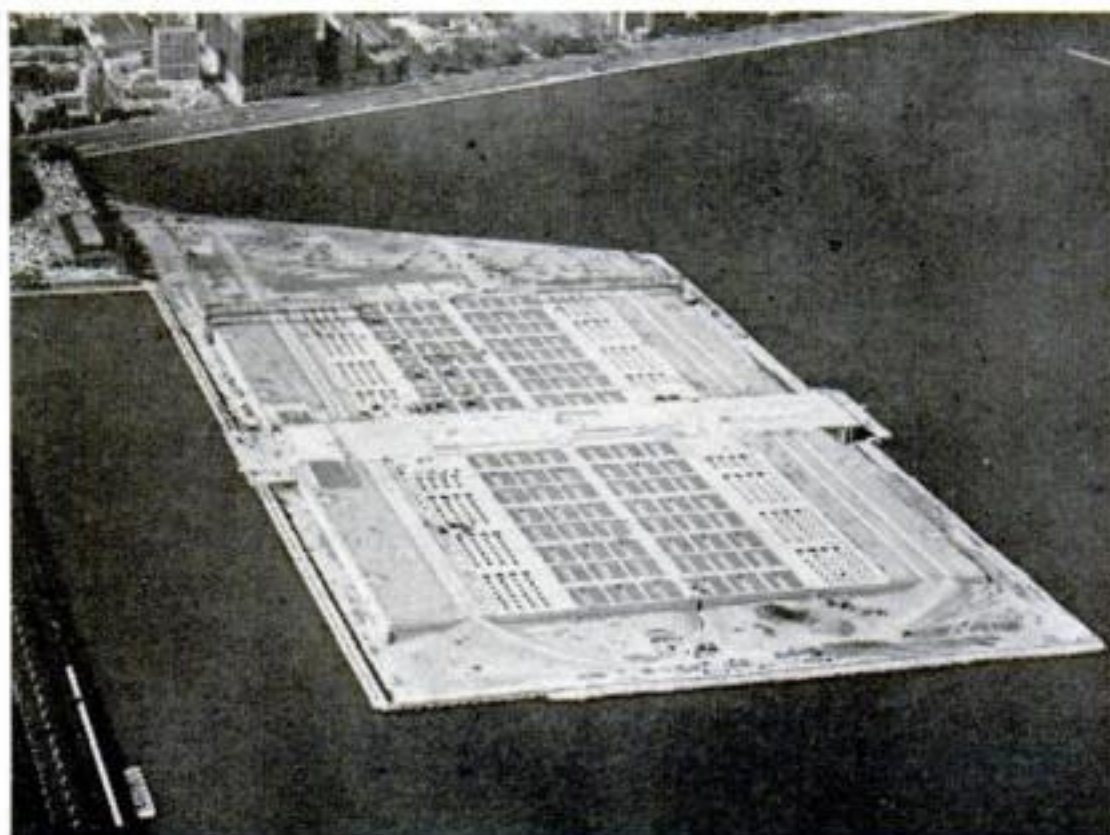
Even a black cat hiding in a coal bin at night can't escape a new camera fitted with an infrared tube the size of a lipstick. The little tube picks up and reveals heat rays from the cat's body.

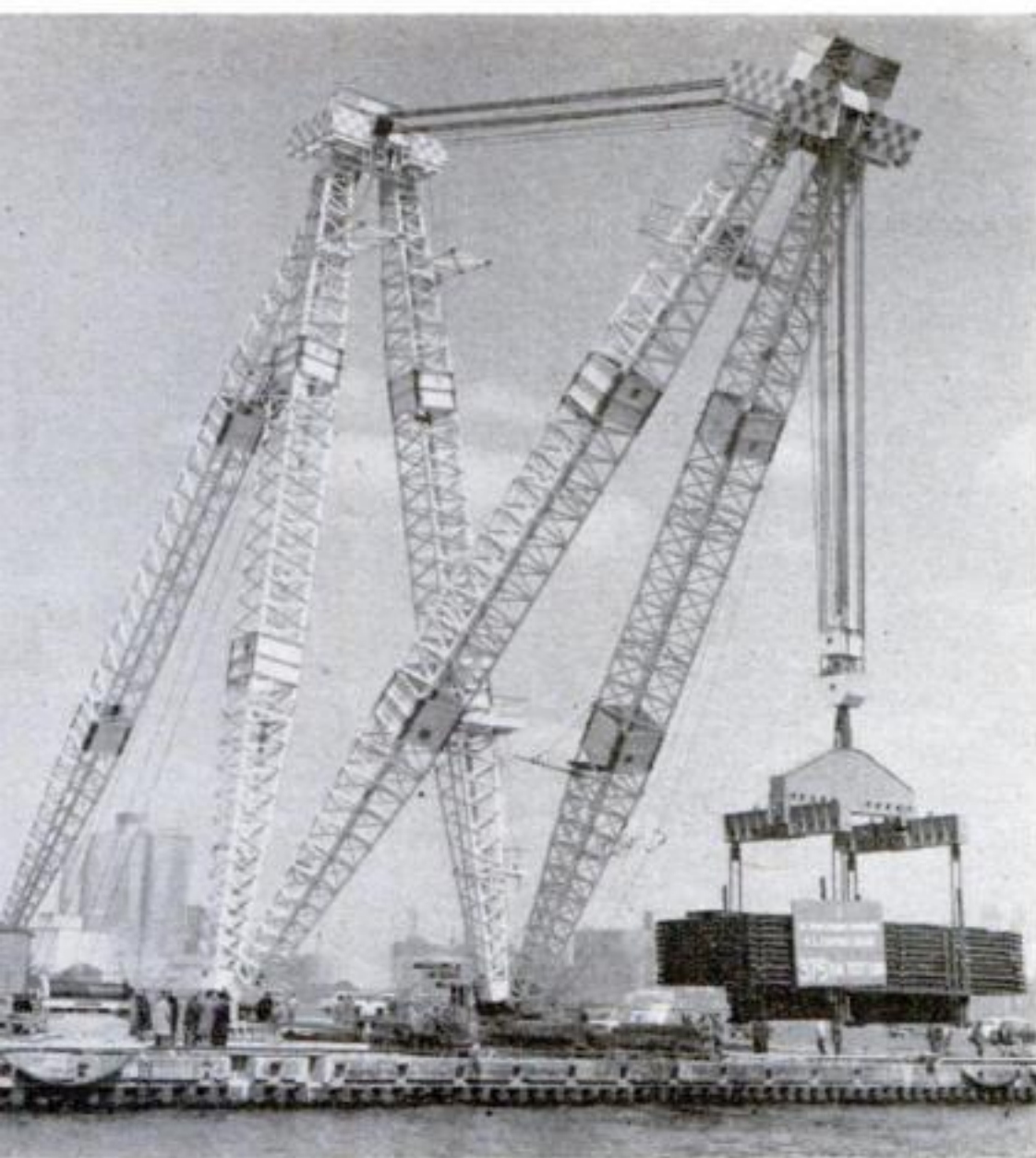
The tube was developed by Minneapolis-Honeywell for night-time mapping by planes flying at jet speeds. It's said to be twice as sensitive and 10,000 times more responsive to faint radiation than earlier detectors, can reveal underground facilities and even the heat from a frying pan up to five miles away.

New filtration plant is world's largest

A huge man-made island in Lake Michigan houses a filtration plant that will furnish water for 3,000,000 people in two Chicago water districts.

The dark squares in the center of the island are 96 filtering tanks. They are flanked by 16 crosshatched settling tanks. The plant contains 950 tons of steel pipe, valves, and pumps, all protected from corrosion by a coal-tar coating. It cost \$102,000,000 and will soon go into partial use.





Muscles for port of Toronto

Said to be the most powerful crane in operation in North America, the monster dockside derrick above went to work recently loading ships in Toronto's harbor. It's rated at 300 tons, but in a trial lifted 450 tons straight up, swung a 375-ton load out and down to a ship's hold. The big crane towers 149 feet and cost more than \$400,000. It's paying for itself at charges of \$100 (50-ton lift) to \$2,200 for a full lift.



VW with a Russian accent

Drawing lots of attention here on a Moscow street is the Zaporozhets, Russia's new "people's car." The car is named after the town of Zaporozhye, in the southern Ukraine, where it's made. The rear-mounted air-cooled engine develops 26 hp., to give a claimed 69 m.p.h.



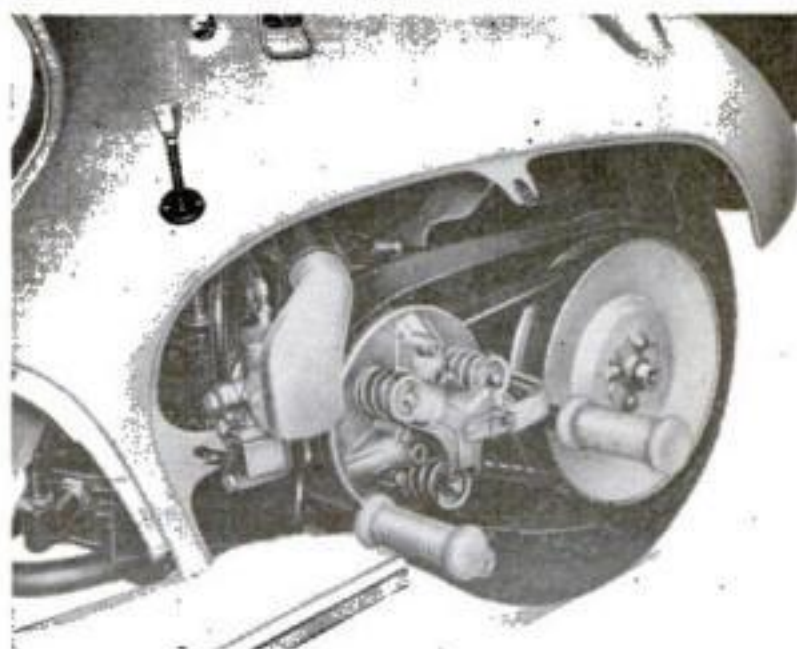
Little scooter tops 40 m.p.h. Its power comes from a 6.1-cu.-in., 4½-hp. engine.

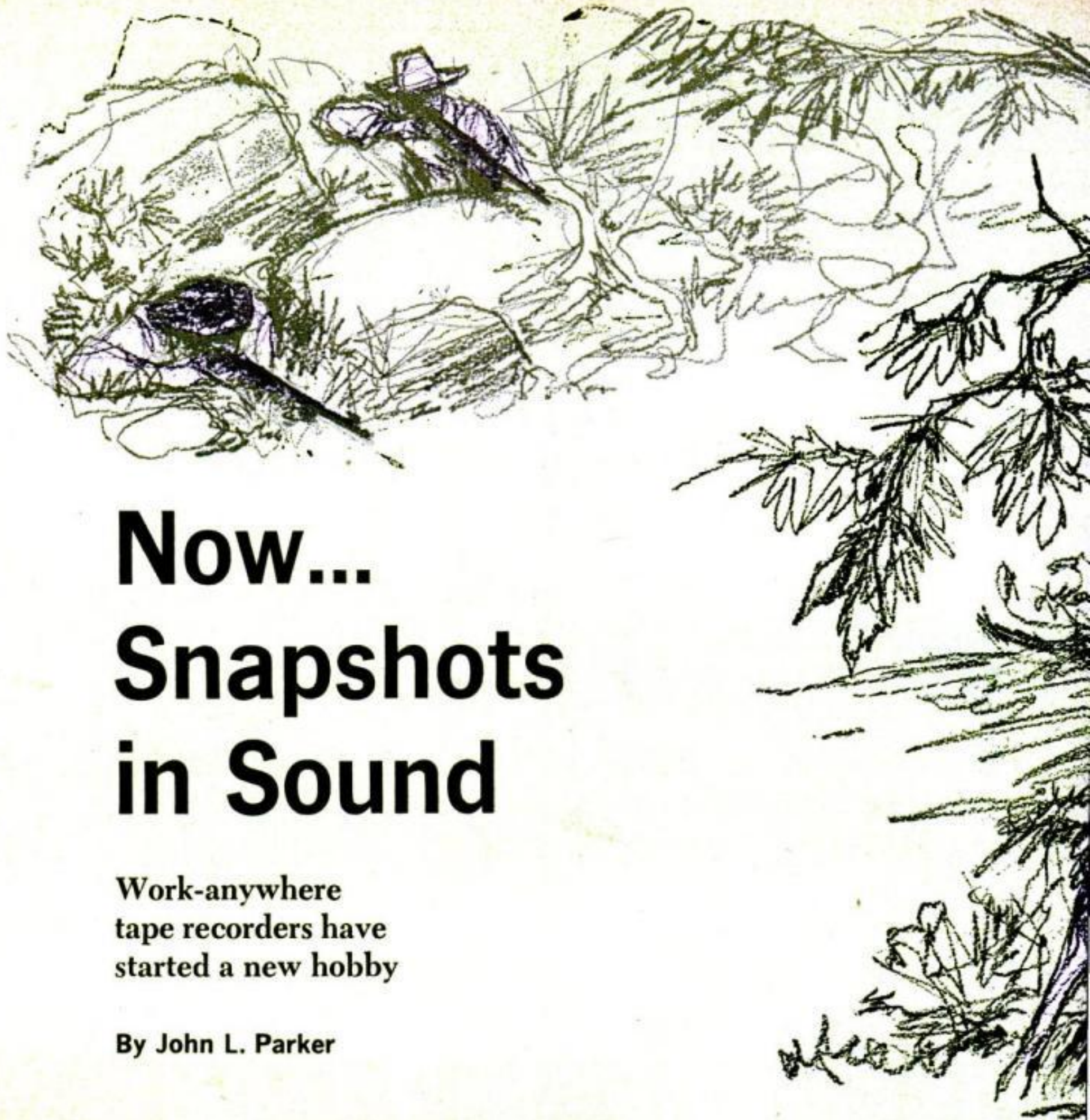
Scooter without gears

An infinitely variable automatic transmission, similar to that of the Dutch DAF mini-car, is used on the new Tina scooter made in Britain by Triumph Engineering. Split V-belt pulleys provide ratios of 15:1 to 5:1.

The input pulley is spring-loaded open, its two halves spread apart for minimum diameter. Revving the engine speeds up pulley rotation; three steel balls in the pulley are thrust outward by centrifugal force. This closes the pulley and increases its diameter by forcing the belt up the beveled flange. As the belt tightens, it decreases the diameter of the output pulley—which is spring-loaded closed—by forcing it open. The scooter gets 100 m.p.g.

Belt rests at idle on a ball bearing in the input-pulley shaft without contacting the separated halves (below). Feeding gas forces the pulley shut, engaging the belt with a clutchlike action.





Now... Snapshots in Sound

Work-anywhere
tape recorders have
started a new hobby

By John L. Parker

RECENTLY two imaginative Arizona hunters borrowed an old hen turkey and recorded her querulous gobbling on a portable tape recorder. Later, by playing the tape out on the desert one weekend, they lured ten coyotes and two bobcats into shooting range.

Another owner used his portable recorder to tape an intermittent noise in his car, played it back in his service station. A mechanic quickly diagnosed the trouble.

The camera-size, battery-powered tape recorders have spawned a new hobby. You can make snapshots and portraits with

sound, just as amateur photographers do with light. And, following the example of the photographers, you can use tapes to expand and enrich your other hobbies.

Portable tape recorders are not new, but only recently have they become light, sturdy, and reliable enough to be slung over the shoulder and used like a camera. You can buy them in almost any size, shape, and type to meet the needs of everyone from a professional newscaster to a high-school student who wants to fill his notebooks the easy way. Prices range from \$19.95 for a drugstore special to over \$900 for



a fancy professional job with all the trimmings. You can even satisfy a secret yearning for cloak-and-dagger work with one that comes disguised as a briefcase and can pick up a whisper 25 feet away.

Tape speeds vary from 15/16 inches per second (i.p.s.) to 15 i.p.s. Other things being equal, the greater the speed, the better the fidelity. Many models operate at two or more speeds. Reel sizes are from 2½ inches with a recording time of 70 minutes to 7 inches with 4 hours' recording time. Recently one tape manufacturer introduced a subminiature 40-minute tape reel the size

of a 50-cent piece. Some recorders have a single reel that rewinds back on itself, something like an endless belt. Two use wide Mylar belts.

In this electronic smörgåsbord, you will want some guidance to narrow the selection to those recorders that fit your needs and purse. Most portable recorders cost between \$100 and \$200. There are several excellent recorders for slightly less than \$100 and many that are priced well above \$200. Unless you have special requirements, however, you should be able to find an excellent tape recorder suitable for

nearly every use in the medium-price range. I have been working with portable recorders for several years and have been able to find machines in this price range with fine tonal qualities, faithful reproduction, and the solid construction required for the rougher handling given portable equipment. Remember, too, if you just want to play around and learn about recorders inexpensively, drugstore counters are loaded with small tape recorders from \$19 up. These machines produce tapes that can't be played on another recorder, usually not even another recorder of the same make.

Speed standards. The big difference between quality recorders and the cheapies is the capstan drive. This is the unit that maintains control of the tape traveling through the recording and playback heads. It functions like a governor so that when a recording is made at a tape speed of 3¾ i.p.s., for example, the tape can be played back on any other machine operating at this speed. International speed standards have been set for tape recorders so that if you join an international tape-recording club and correspond through tapes with friends in other countries, the tapes you send and receive will play on any recorder operating at the same speeds.

Most portable recorders operate at 1½ or 3¾ i.p.s. Many feature both speeds. The slower speed is fine for voice, the faster speed does a creditable job in reproducing AM music and tonal sounds. These two speeds are generally regarded as the most satisfactory for the small battery-powered recorders. They provide adequate recording time without excessive battery drain.

Nearly every machine on the market is foreign made. Most are from Japan and Germany. This goes for machines bearing American brand names as well as those handled through importers.

Most of these imports, selling for \$50 or more, are well made, and are designed to withstand rugged use. They seem to vary more in the quality of their accessories—microphones, earphones, telephone-recording attachments, and supplemental controls—than in basic machinery. The better units have dynamic microphones not affected by high temperatures and more resistant to damage. Many of the small recorders have a built-in speaker; most of them have an earphone jack.

Like all electronic equipment, tape recorders abhor dirt. They must be kept clean

With a little ingenuity



Bring home sounds of faraway places.



Pin down intermittent noises.

to do their best. When they aren't at their best, you'll hear the difference.

Because of their magnetic iron coating, tapes tend to collect dust, as do the recording and playback heads. Keep them under cover when not in use. The recording head, erasing head, tape guides, capstan, and pinch roller are subject to an accumulation of tape-coating residue. Use a soft cloth or a small wad of cotton, wrapped around a toothpick, which has been saturated with methyl alcohol. It is not advisable to use any other type of solvent for cleaning. A vacuum cleaner, with its dusting-brush attachment, offers the best way to remove dust from exposed parts. Never use metal or sharp-edged instruments around the recording head. They can damage or produce undesirable magnetic effects on the heads. Make sure that all parts are dry before using the recorder.

Heat and cold. Recorders are also sensitive to heat and cold. If the unit has been

you'll find new uses for a carry-along recorder every day



Record nature sounds you never heard before.



Remember all the turns.



Capture amusing sounds anywhere.



Fill a notebook painlessly.

in a cold place for some time, let it warm up for a few minutes before recording. Remove the tape and operate it on play. After a few minutes the tape speed will become constant. Avoid direct sun or heat when using a unit. Transistors are vulnerable to heat. The recorder should never be left in a car with the windows closed where there will be excessive heat build-up. If the recorder has a crystal microphone, the heat will ruin it.

It is advisable to have your recorder checked over and oiled at least once a year by a competent service department.

If the recorder is to be idle for a long time, remove the batteries and store them in the refrigerator. If you use your recorder where house current is available much of the time, you may find it worthwhile to use an AC adapter which plugs into an outlet.

About tapes. Because tapes are normally used repeatedly, quality is important.

Most portable tape recorders take stand-

ard 3- or 3½-inch reels with variable playing times depending on the speed of the recorder. Nearly all recorders have two-track recording and playing heads. Playing time is doubled by turning the tape over after one half has been used.

Standard tape lengths on the 3-inch reels are 150, 225, and 300 feet. The recording time per track on a 150-foot tape is 15 minutes at 1½ i.p.s., 7½ minutes at 3½ i.p.s. Some 3½-inch reels have a special thin 600-foot tape that will play one hour per track at 1½ i.p.s.

User experience has not always been satisfactory with ultrathin tapes on portables. The tapes tend to bleed. They do not erase properly, and retain an echo of the previous recording. I have found that the thinner tapes, after repeated use, tend to excessive magnetic build-up, almost like static electricity, and do not unwind freely from the reel. This puts a heavy drain on

[Continued on page 193]



Tenax uses zone-focusing symbols and fully automatic exposure control.



Minolta EE is a fully automatic subminiature with 16mm film magazine.



Rollei-Magic II selects about everything for you except the focus. Camera automatically sets shutter and aperture.

Automatics!

those still cameras with "brains"

How good are they? Some experts predict all amateur cameras will eventually be fully automatic

By Arvel Ahlers

TO a degree considered impossible a decade ago, today's automatic cameras literally "think" for themselves. All you do is aim the camera and shoot.

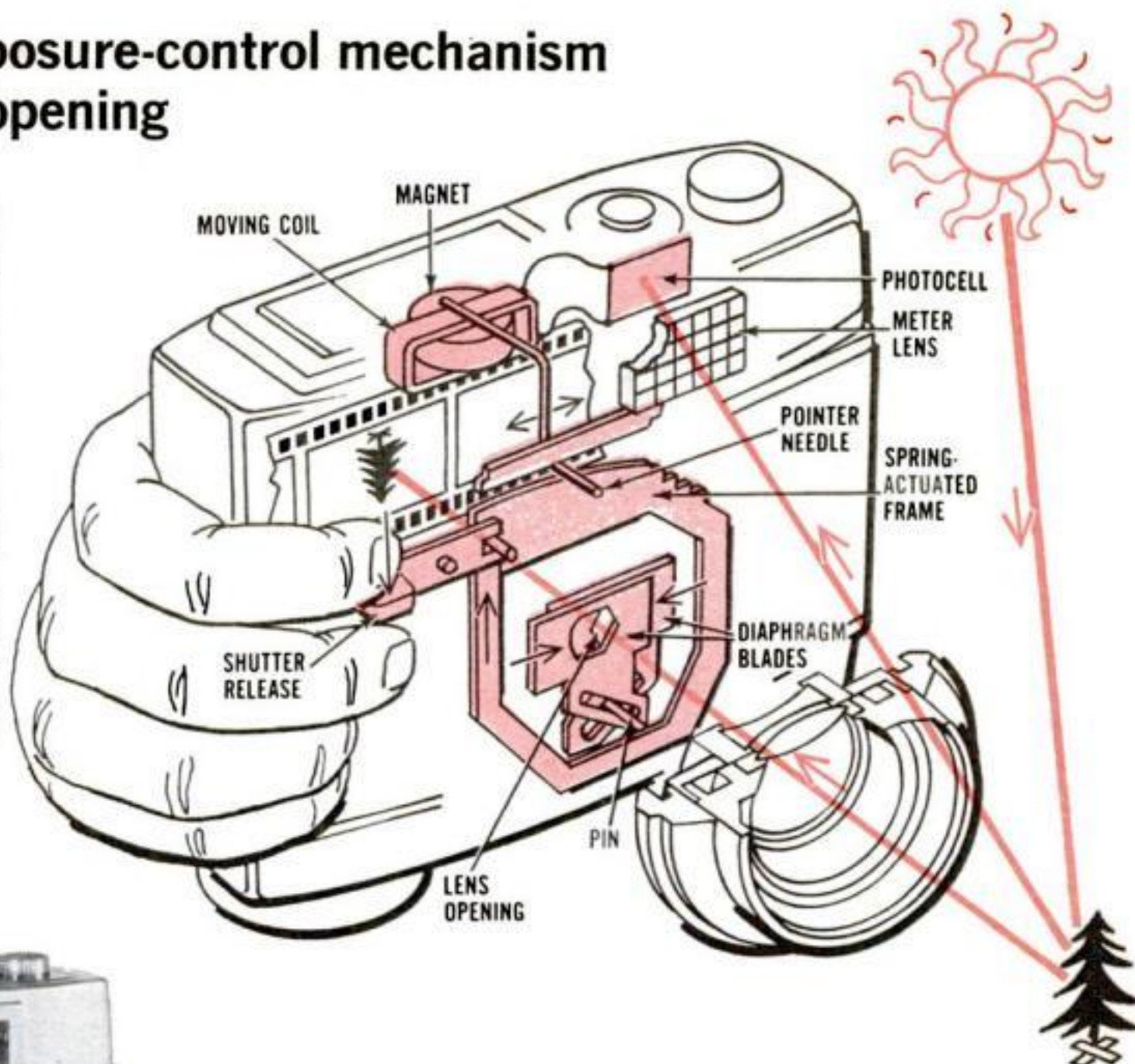
Cost? For less than \$20 you can own an automatic that even the youngsters can use, or you can flirt with a \$300 gem, or settle for something comfortably in between.



Under the "big top." An amateur photographer made this shot under existing-light conditions. Using an automatic Voigtlander camera loaded with Tri-X film, he aimed and shot.

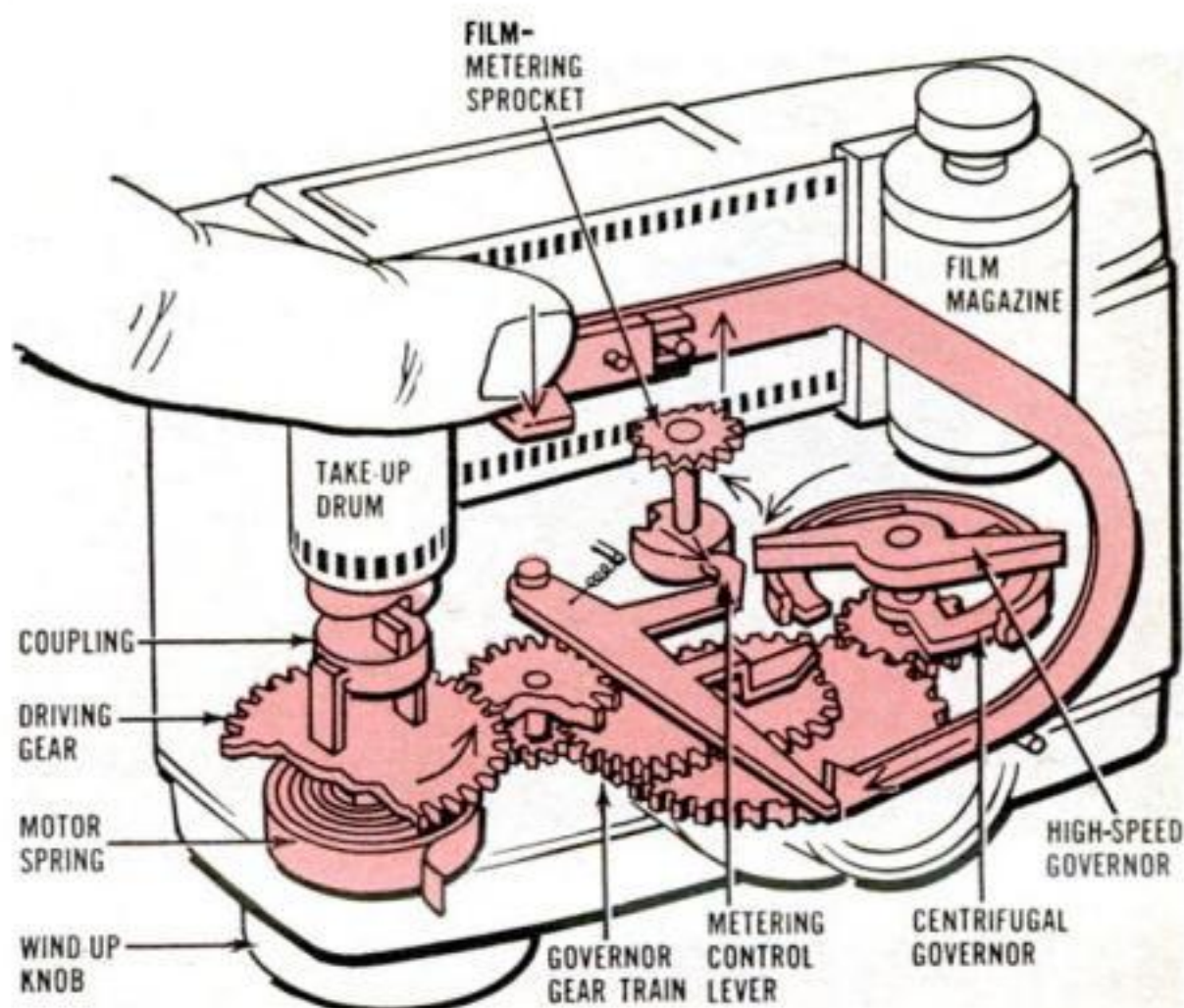
How a typical exposure-control mechanism adjusts the lens opening

Aiming camera admits light into exposure meter. A photocell inside meter generates current that varies with brightness of subject, producing energy that causes the meter pointer to move accordingly. Depressing the shutter-release lever raises the spring-actuated frame. Frame, curved at top, rises until it touches pointer. A pin in the frame bottom, pushing against blades, opens diaphragm as it rises. In too dim light, stepped portion of frame contacts pointer, and warning signal appears.

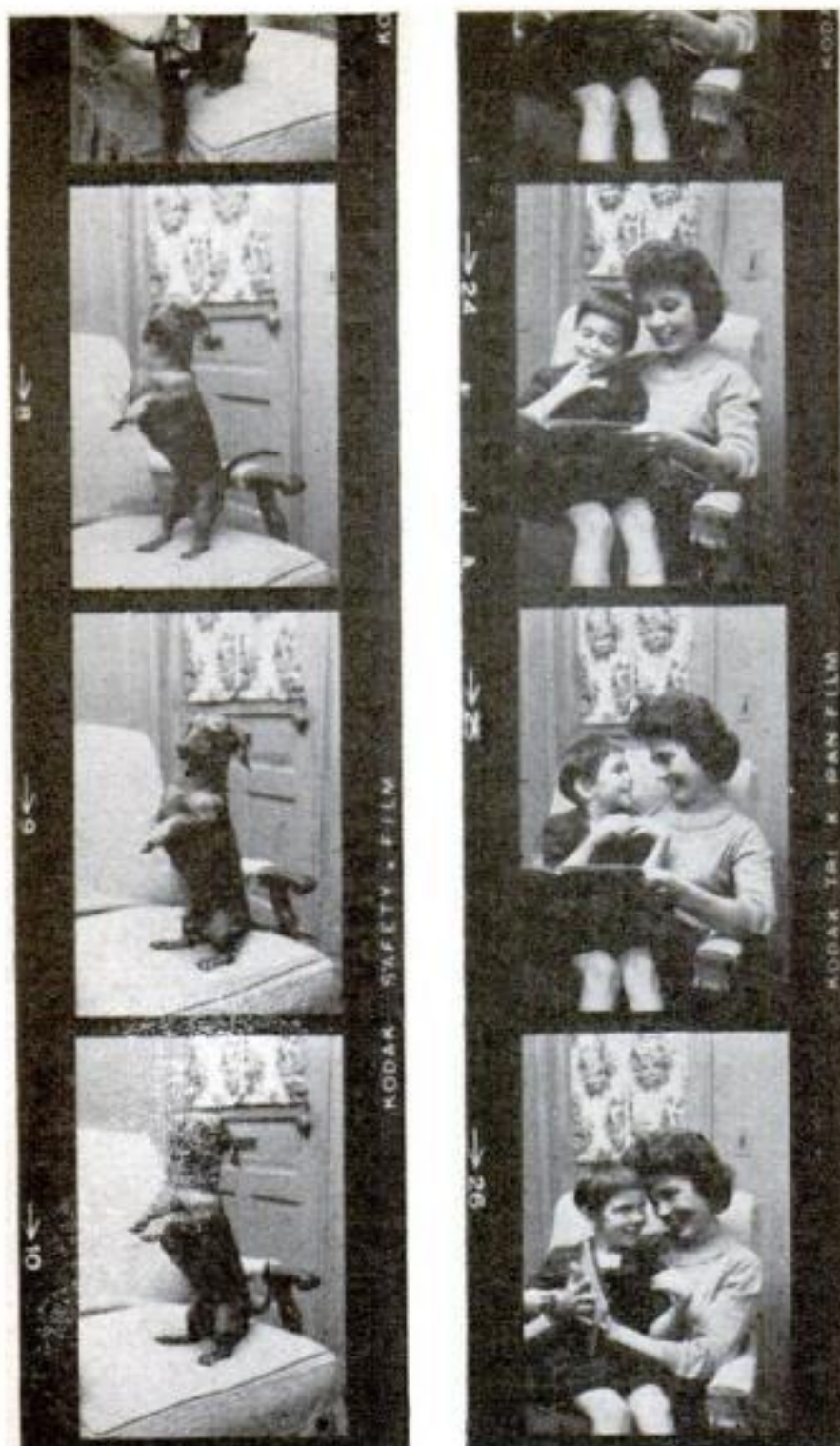


Spring drive advances the film 10 frames without rewinding

Spring-motor film advance lets the Motomatic 35 fire 10 frames without rewinding. Turning the wind-up knob stores energy in the spring. A governor system controls the rate of film advance. Operating from the driving gear is a four-stage governor gear train that multiplies the speed to 8,000 r.p.m. The film-metering sprocket makes one revolution per frame. At each revolution, the metering-control lever drops into a notched cam driven by the sprocket. It causes another arm of the lever to block the high-speed governor, stopping the motor.



CONTINUED



Automatic motorized cameras fire single exposures or bursts. The sequence strips above were made with a Kodak Motormatic 35 camera.

Man's first outer-space camera



Lt. Col. John Glenn used this Anso Autaset to take the first 35mm pictures ever shot by man in outer space. Viewfinder was from different camera.



New Fujica Auto-M lets you preselect the exposure combination you want. The camera does everything else.

What does having a camera with a built-in "brain" mean in picture-taking terms?

It means that the time-consuming part of picture-taking, the arithmetic and mechanics of figuring out exposures and making lens settings, has been taken over by the camera itself. You can keep your eye glued to the viewfinder, ready to shoot the instant an expression is right or the action becomes dramatic. If a cloud covers the sun, or your subject saunters into the shade, the camera's electric eye automatically adjusts the lens opening for a correct exposure.

This doesn't mean that the fully automatic camera is the answer to every photographer's dream. But unless you're an expert at handling exposure problems, your results with an automatic will at least be more consistent than with a manual.

There are many degrees of automatic exposure control. Generally, however, "automatic" means some sort of hookup between a built-in light meter and the camera's lens-opening and shutter-speed mechanisms.

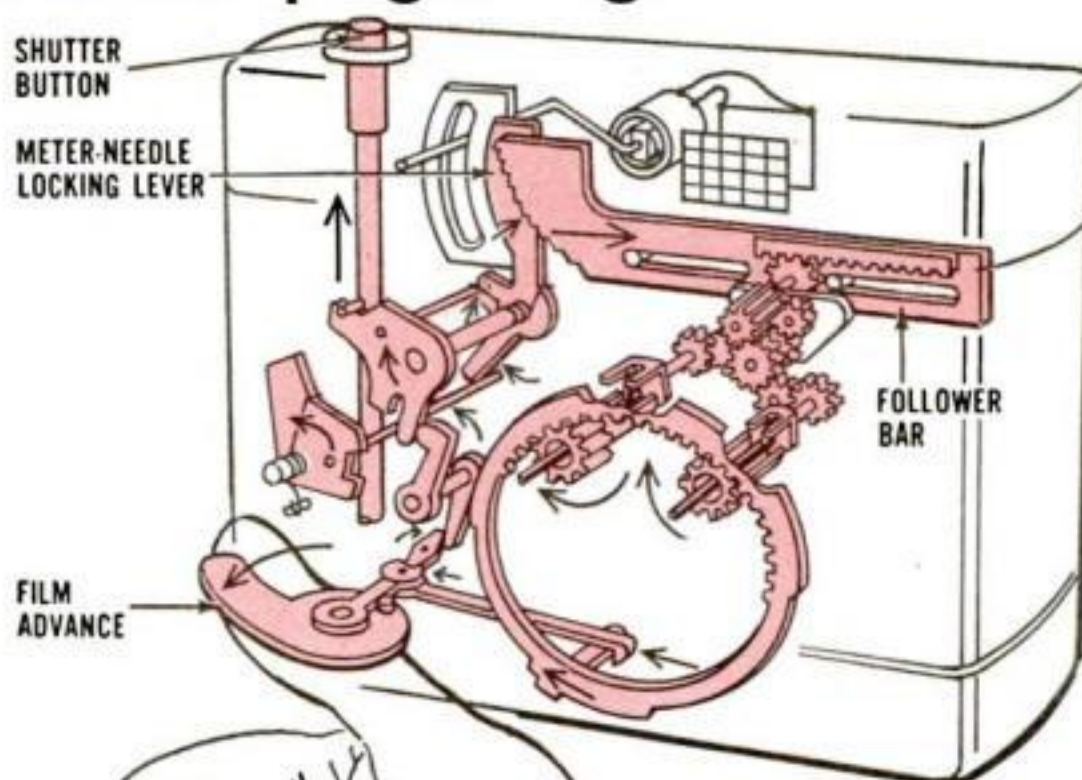
The brain in most automatics consists of a photocell, an ultra-sensitive ammeter that measures the minute flow of current generated by light striking the photocell, and a programming device that translates the movements of the meter needle into lens openings—and often shutter speeds, too.

In a fully automatic camera, you set the camera for film speed, then aim and shoot. On a typical automatic, the lens opening locks long enough for the shutter to open and close at its preselected shutter speed. Some new cameras automatically shift the shutter speed to a higher or lower setting when the light is too dim or too bright for any of the available lens apertures.

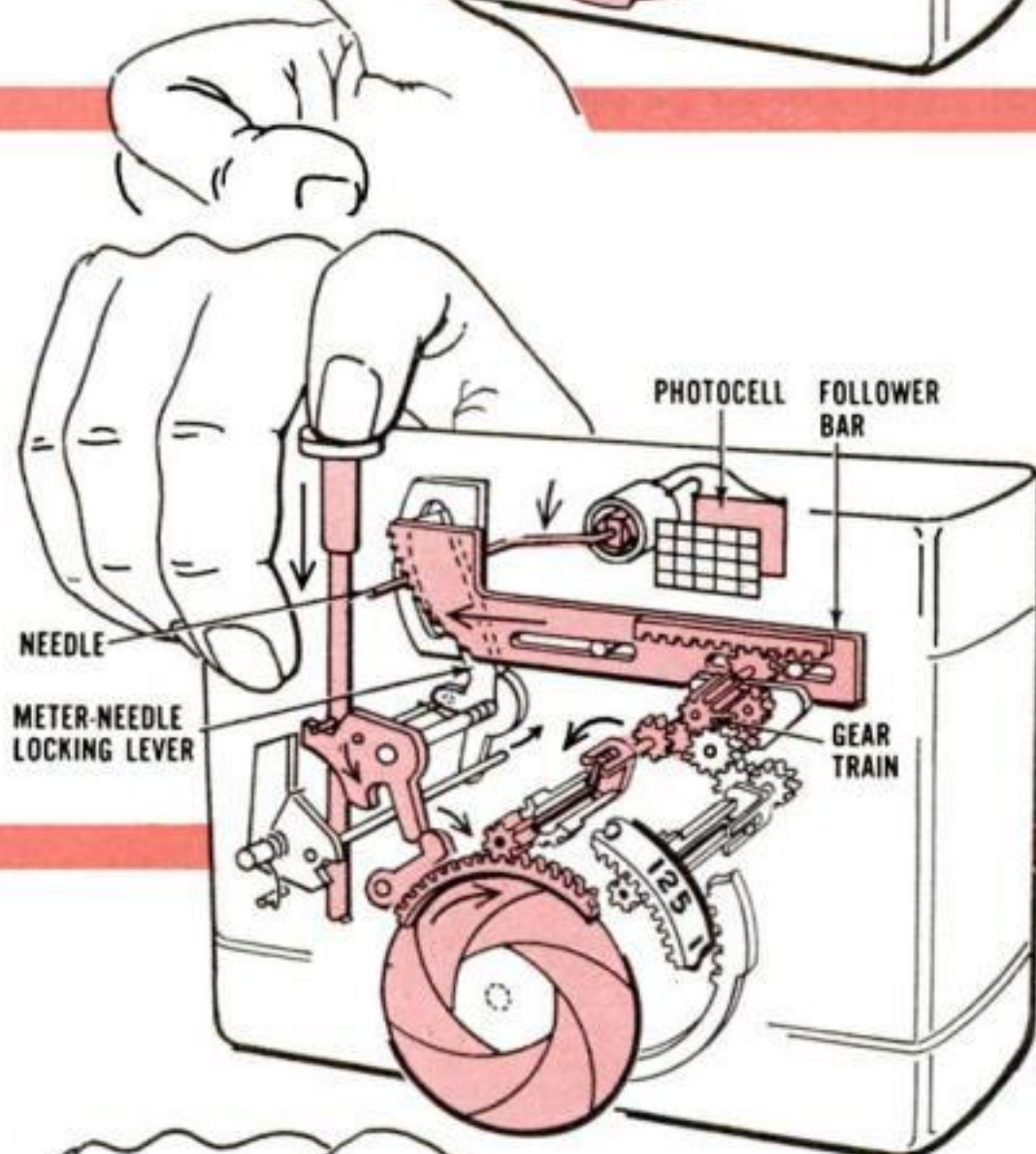
Beginning with tiny precision cameras
[\[Continued on page 180\]](#)

How Fujica's exposure-shutter programming works

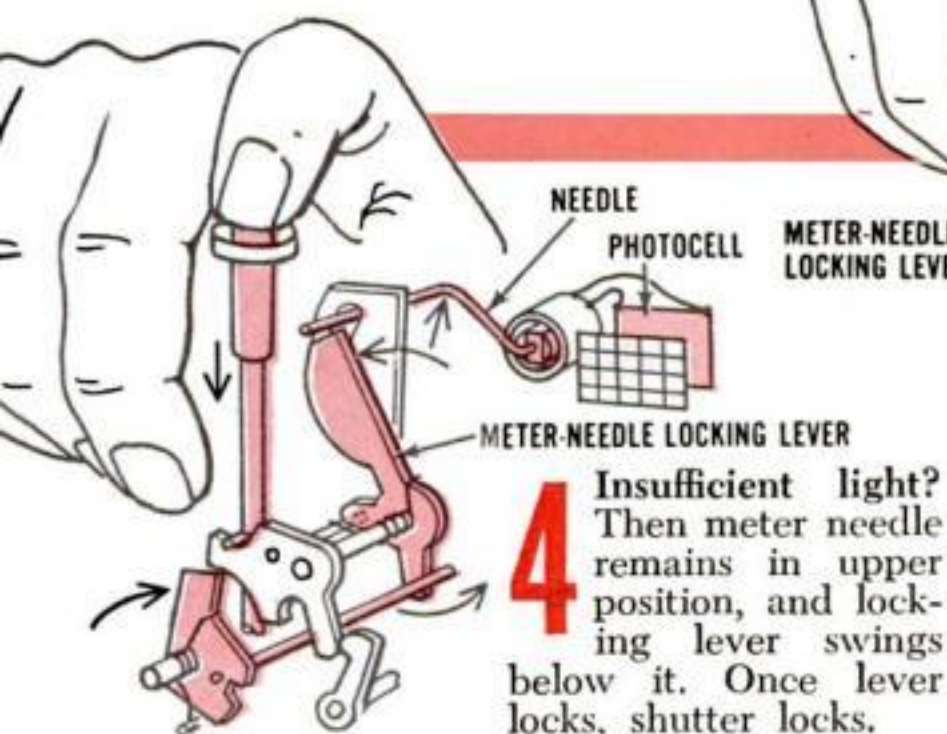
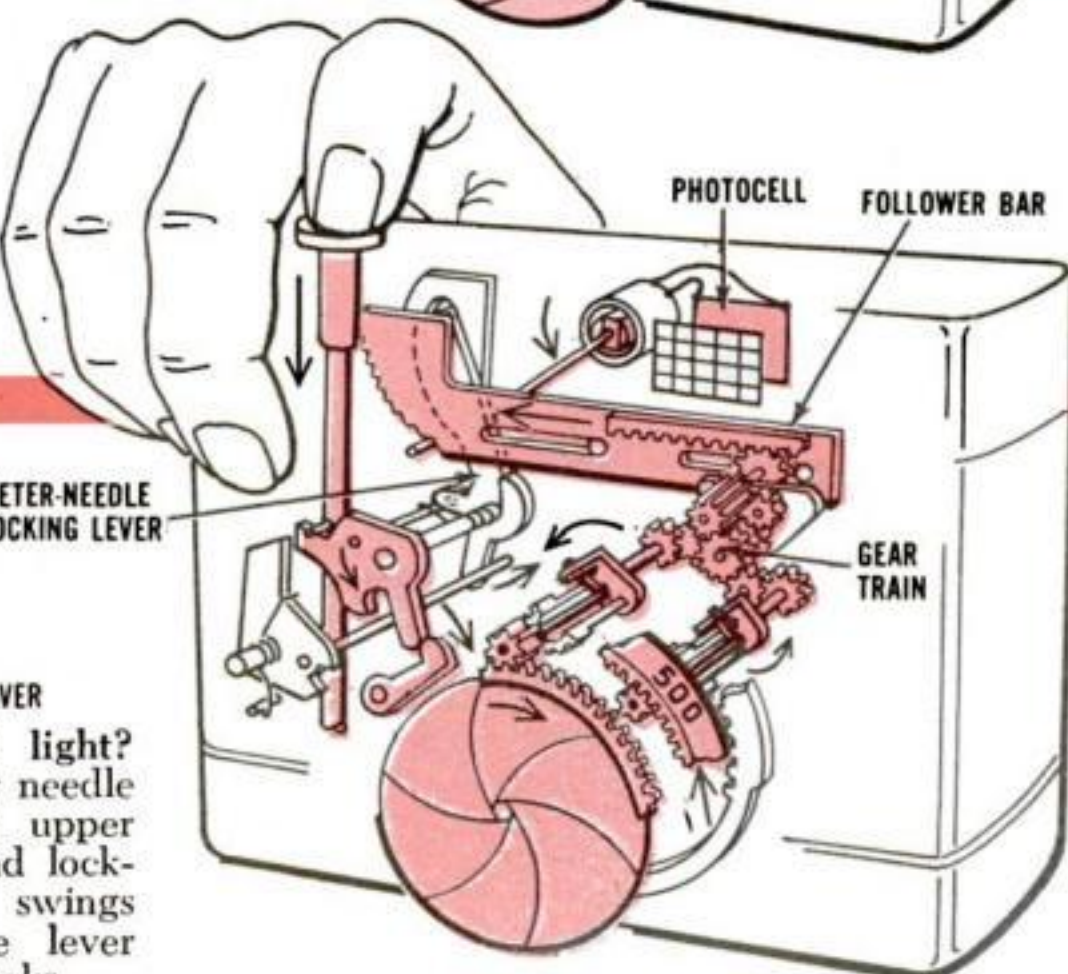
1 With film speed and shutter range set on the Fujica Auto-M, you rotate the film advance to set the stage for the operations that follow. In this first stage, the shutter button raises to the operating position. By means of a gear train, the meter-needle locking lever swings to the right and the follower bar moves to the right as far as it can. The operation activates the diaphragm and shutter. You are then ready to aim and shoot.



2 With normal outdoor lighting the shutter will generally be preset to 1/125 second. When you push the shutter button, a series of mechanical steps makes the meter-needle locking lever swing against the needle. The follower bar moves until one of the notches strikes the meter needle. Rack in follower bar turns the gear train as it moves, adjusting the diaphragm to the correct exposure.



3 Too bright: What happens if there's too much light for shooting at 1/125 second, even with lens stopped down to f/16? Other gears in train come into play and shift the shutter speed, first to 1/250. If the exposure is still too much, it will shift to 1/500.



4 Insufficient light? Then meter needle remains in upper position, and locking lever swings below it. Once lever locks, shutter locks.

How to Get Started in

It isn't as hard or as costly as you may think to get in on this exciting tool-of-many-uses

By John Burroughs

AS YOU adjust the needle valves to feed a one-to-one mixture of oxygen and acetylene through a gas welding torch, the softly purring tongue of bluish flame from the tip reaches a phenomenal temperature—nearly 6,300 degrees.

This is hot enough to fuse steel (melting point 2,500 degrees) as a match flame melts candle wax.

That lick of superhot fire is one of the most interesting, most versatile, most valuable shop tools you could own. For with an oxyacetylene torch you're equipped to fabricate almost anything that can be made of metal—anything from silver-brazed jewelry to welded-steel boat trailers. With a gas welding outfit you're able to shop-build metalware for which you'd otherwise have to lay out sizeable sums of cash: steel furniture, say, or tool stands, back-yard

You can both join and cut metal with a dual torch like this

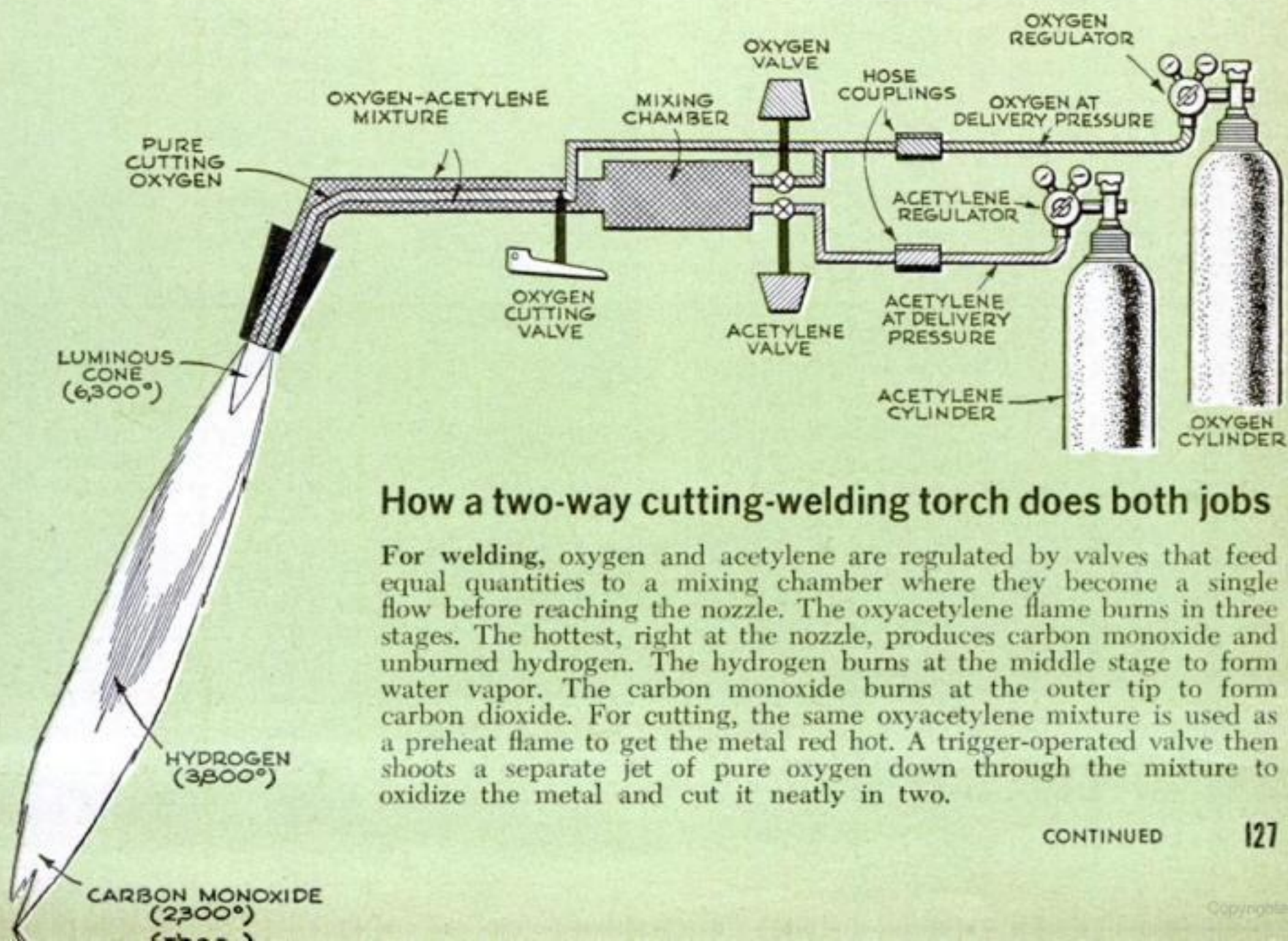
Cutting: Sparks fly as jet of pure oxygen burns through this heavy steel bar. Special cutting tip has four small flames that preheat the metal before the pure oxygen is turned on.

Welding: Same torch, with welding tip, mixes oxygen and acetylene to bend this steel tubing. Bend is made by hacksawing slots to let tubing curve, then welding the slots closed.



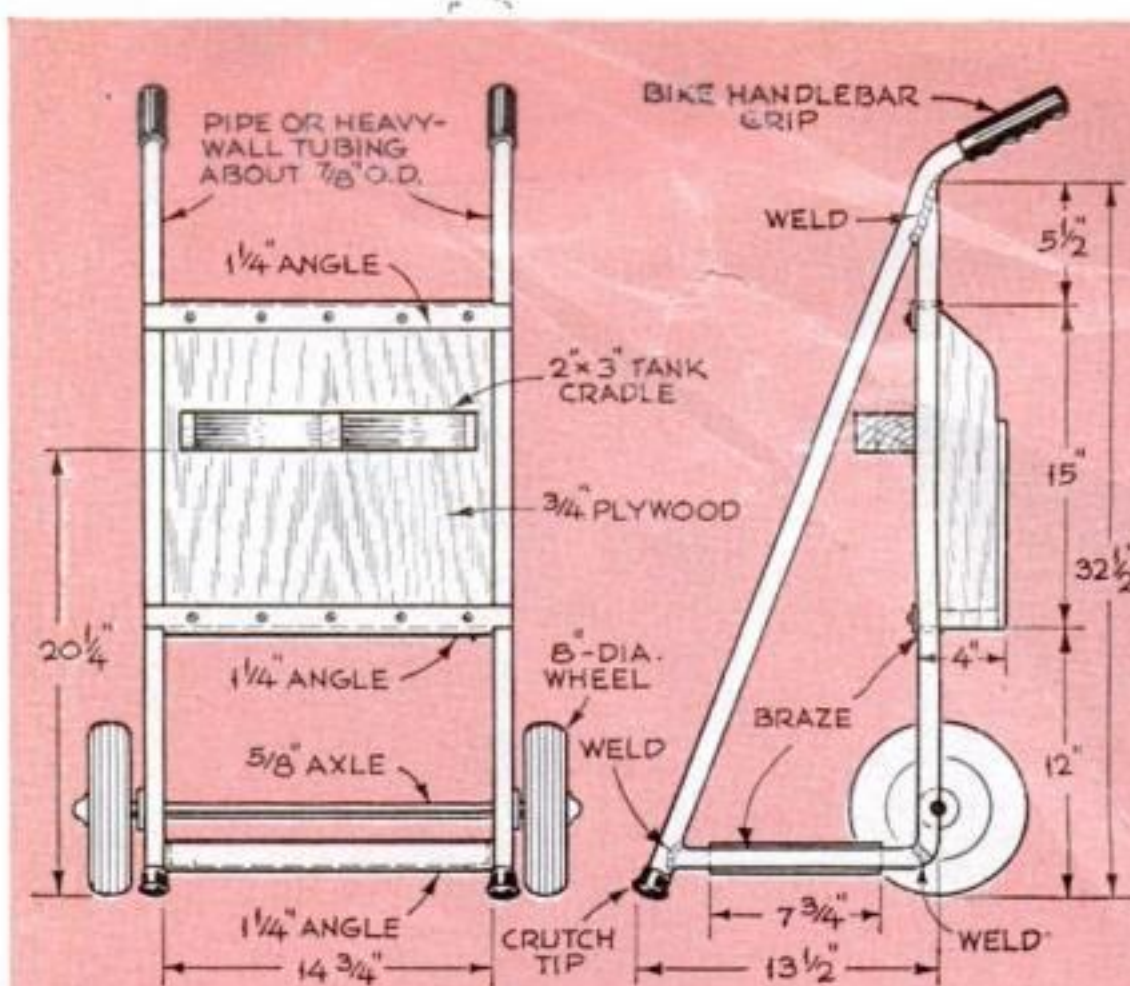


A table topped with firebrick and a wheeled caddy for the tanks are handy extras you can build.



How a two-way cutting-welding torch does both jobs

For welding, oxygen and acetylene are regulated by valves that feed equal quantities to a mixing chamber where they become a single flow before reaching the nozzle. The oxyacetylene flame burns in three stages. The hottest, right at the nozzle, produces carbon monoxide and unburned hydrogen. The hydrogen burns at the middle stage to form water vapor. The carbon monoxide burns at the outer tip to form carbon dioxide. For cutting, the same oxyacetylene mixture is used as a preheat flame to get the metal red hot. A trigger-operated valve then shoots a separate jet of pure oxygen down through the mixture to oxidize the metal and cut it neatly in two.



Tank caddy like this is a fine exercise in welding know-how

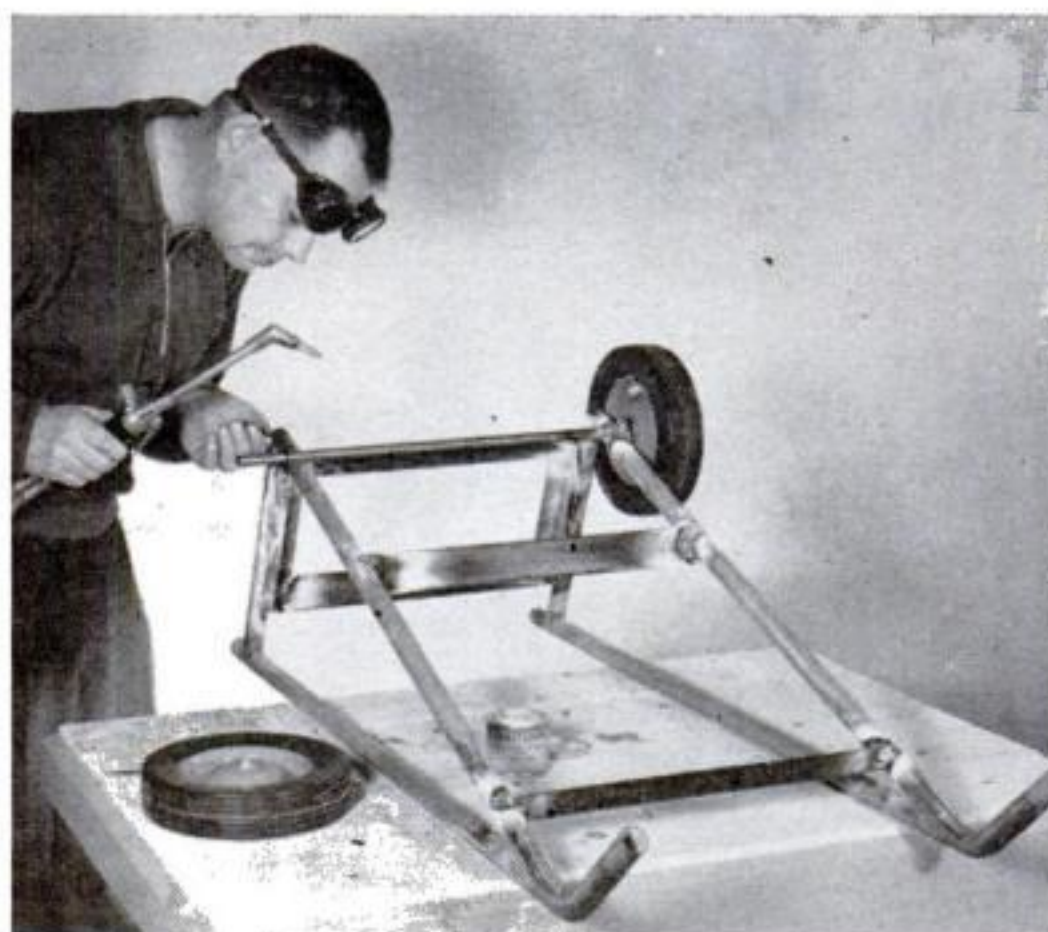
swings, porch railings, kart frames, garden barrows. Three or four projects like these can save you more than the cost of your welding equipment.

And with your torch you can repair machinery. In auto repair, for instance, oxyacetylene equipment is almost indispensable for rebuilding parts, mending broken castings, straightening bent frames, patching body dents and tears. Ask any mechanic.

Yet, for some reason—misconception, perhaps—the gas welding torch isn't a common tool in home shops. You'll hear that oxyacetylene welding is beyond the scope of ordinary basement shopwork, and that the equipment is expensive to buy, costly to operate, and hazardous to use.

This simply isn't true. While production-line welders can cost hundreds of dollars, it's possible to get together a small, shop-size oxyacetylene outfit for less than the cost of, say, a good table saw. A relatively inexpensive light-duty torch with tips capable of welding steel up to $\frac{3}{8}$ " thick will handle any job a home craftsman is likely to tackle—unless he builds locomotives in his spare time. And *small* gas welding torches aren't costly to operate. When you're doing light welding with small tips, one set of gas tanks lasts for a good many hours of torch work.

Hazards? Special skills? Take ordinary

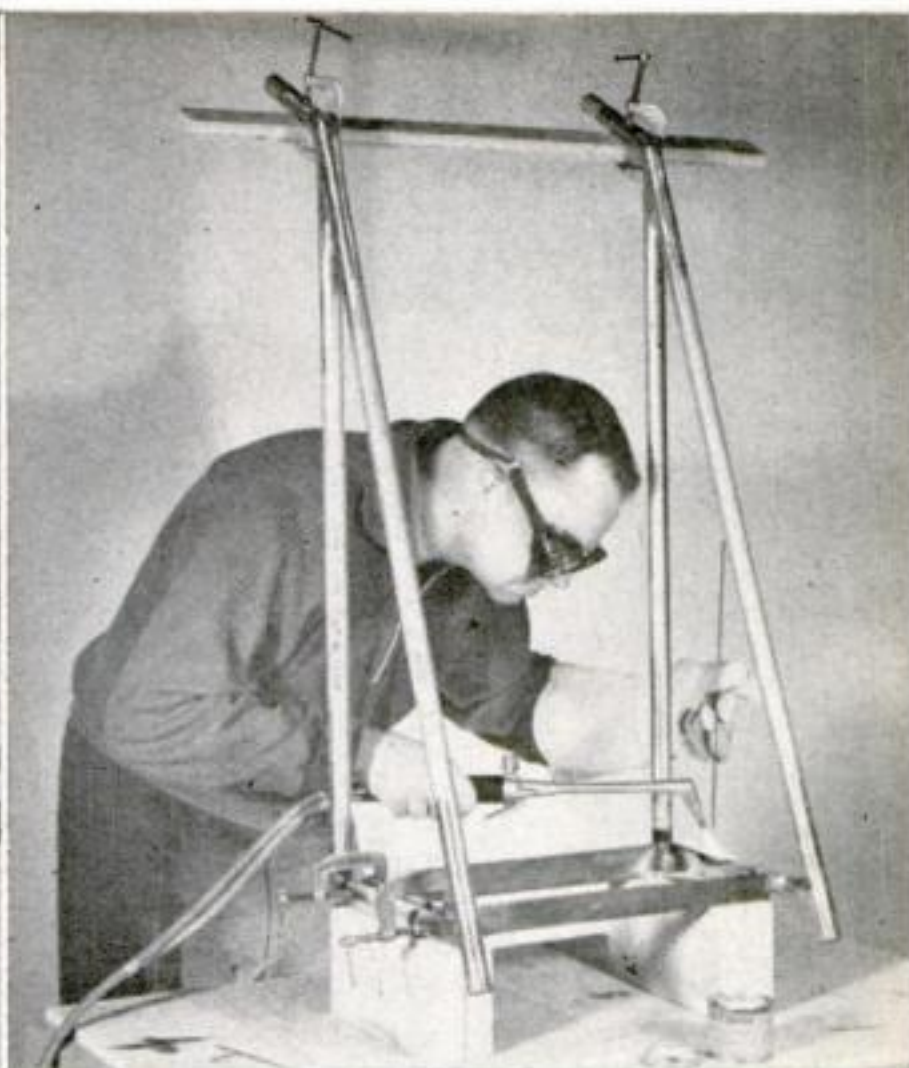


Attaching the axle makes use of a helpful trick for joining round parts. Set the axle into filed notches. They'll hold it in place and increase contact area for a strong joint.

common-sense fire precautions and you can gas-weld in your basement with complete safety. So long as your torch and tanks aren't used commercially, they won't affect your household insurance coverage. And no great skill is needed. Though some welding jobs are rather tricky, welding ordinary mild-steel pipe, tubing, rod, angle, channel, sheet,



Proper alignment of parts is an important first step. Here, a triangular side frame for the tank caddy is laid out flat on a full-size pattern to insure correct angles at joints.



Tack-brazing is a good way to join parts temporarily. Caddy's sides are clamped to base and tacked at intervals before final brazing. Brace clamped to handles keeps sides parallel.



Angle-iron cleats make ideal supports for attaching a wood part to metal such as this bin for welding supplies. Handles are bent by slot-weld method shown on a previous page.



Tank cradle is a two-by-three block jigsawed to match cylinders and lined with sponge rubber. Web strap to hold the tanks is anchored to cradle ends with screwed-on metal plates.

and plate is hardly more difficult than soft-soldering copper.

Hasn't the arc welder supplanted the gas torch? If you're building skyscrapers, yes. For roughly welded structural-steel work, the arc is faster and cheaper. But oxyacetylene's ease of control and versatility make it a wise choice for run-of-the-shop welding.

The gas flame is far easier to use, especially for the novice welder, than the sputtering spark. And it does a smoother job. You simply can't beat an oxyacetylene torch for sound, slag-free, neatly filleted welds.

How much do they cost? You'll find a number of light and medium-size torches bearing reliable trade names (Purox, Harris,



Prest-O-Lite torch above is a combination cutting-welding type similar to the Sears model shown on previous pages. It's sold by Linde Co. for about \$85, complete with regulators.

Victor) that together with adequate regulators and hose sell for around \$100. Separate oxygen-cutting attachments to fit the torch handles may cost \$25 or so more.

And you'll also see small combination welding-cutting torches. Such torches have three valves—a built-in oxygen-cutting valve as well as needle valves to control the oxygen and acetylene individually. These require no separate attachment for cutting. To use a combination torch for cutting, you simply switch tips. Welding tips are used with an adapter fitting that seals off the cutting-oxygen tube in the torch head and makes the cutting valve inoperative. When you replace the welding tip and adapter with a cutting tip, the cutting-oxygen valve blows a jet of pure oxygen through the tip to "burn" through the steel you're cutting.

There are two reasonably priced combination torches of this design available, both made of bronze and both supplied as part of welding-cutting sets including torch, assorted tips, wrench, hose, regulators, goggles, lighter, and instruction booklet.

Sears, Roebuck sells one of these sets (the torch and regulators shown) for \$66.99. The other set, trade-named Prest-O-Lite No. 420, is sold for \$84.50 by Linde Co., 30 E. 42nd St., NYC. The slightly higher-priced Prest-O-Lite has a somewhat better finish. Either set is a good buy.

Both torch sets include simple, serviceable single-stage acetylene and oxygen regulators. A single-stage regulator has a single dia-

phragm-controlled valve seat governing gas pressure. This type must be reset from time to time as tank pressure diminishes, but it's just as safe and, in everyday shop-work, just as satisfactory as the more expensive two-stage regulators generally used with heavy-duty industrial torches. Each regulator supplied with the sets has two gauges, one showing tank pressure and one delivery pressure.

What about tanks? Besides torch and regulators, you'll need acetylene and oxygen. A tank's measure of size is the number of cubic feet of gas it will release. Ordinarily the oxygen tank used is somewhat larger than the acetylene tank to provide the extra oxygen used in cutting.

Industries use tank combinations of 150 cu. ft. for acetylene and 244 cu. ft. for oxygen. Garages and machine shops generally use 100-cu.-ft. acetylene tanks and 122-cu.-ft. oxygen tanks. When buying gas in these larger tanks, the consumer pays for the contents—the gas—and uses the tanks on loan for 30 days. If he keeps them more than 30 days, he pays four cents per tank per day for the second 30 days—something like a library fine—and thereafter six cents per tank per day.

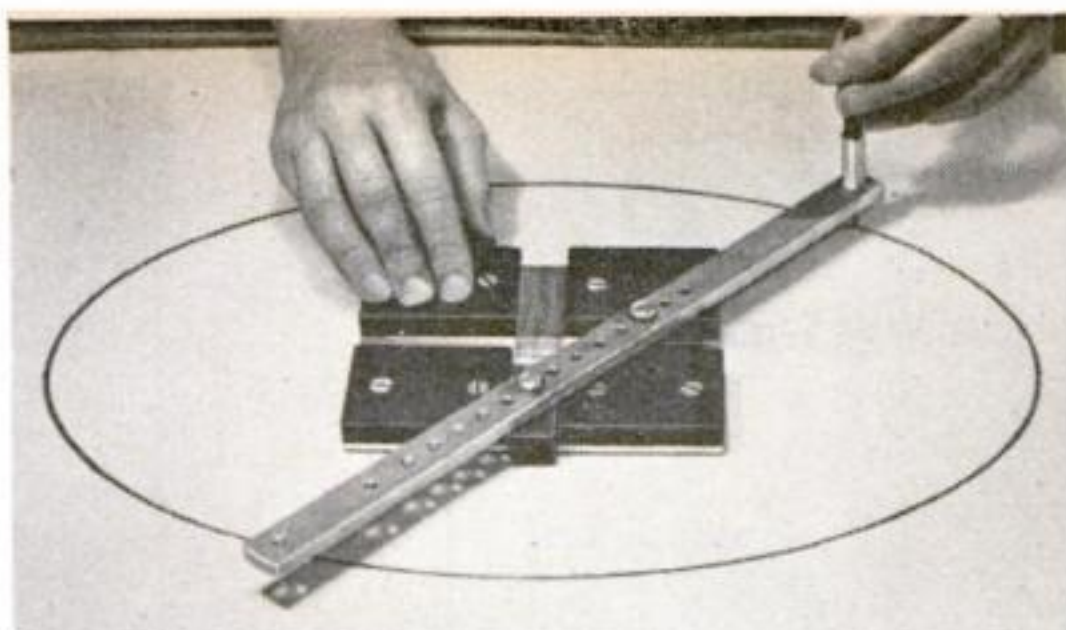
Since these big tanks hold more gas than anyone doing occasional welding is apt to use up within the 30-day free-loan period, they're a poor proposition for average home-shop use. Also, the large tanks are heavy and awkward to handle.

It's the next-smaller tank combination, a 60-cu.-ft. acetylene tank with an 80-cu.-ft. oxygen tank, that's most popular in small shops. About 3' high, 60-80 tanks are small enough for convenient handling, yet hold enough gas to last reasonably long. But there's a hitch: Tanks in this size aren't available on loan. You have to buy them outright, and they cost about \$35 each.

But, owning the tanks outright, you use them until they're empty and trade them in for full ones without paying rental. Trading empty 60-80 tanks for full ones costs roughly \$8. And that's your outfit's operating cost—\$8 for several months of welding.

Smaller tanks are available, but unless you're planning to limit yourself to light sheet-metal welding with small torch tips, you'd rapidly exhaust them. Some dealers, incidentally, refuse to sell 60-80 tanks outright but instead offer them on a 20-year lease for the same price, a scheme devised

[Continued on page 176]



An Ellipse Trammel You Can Make

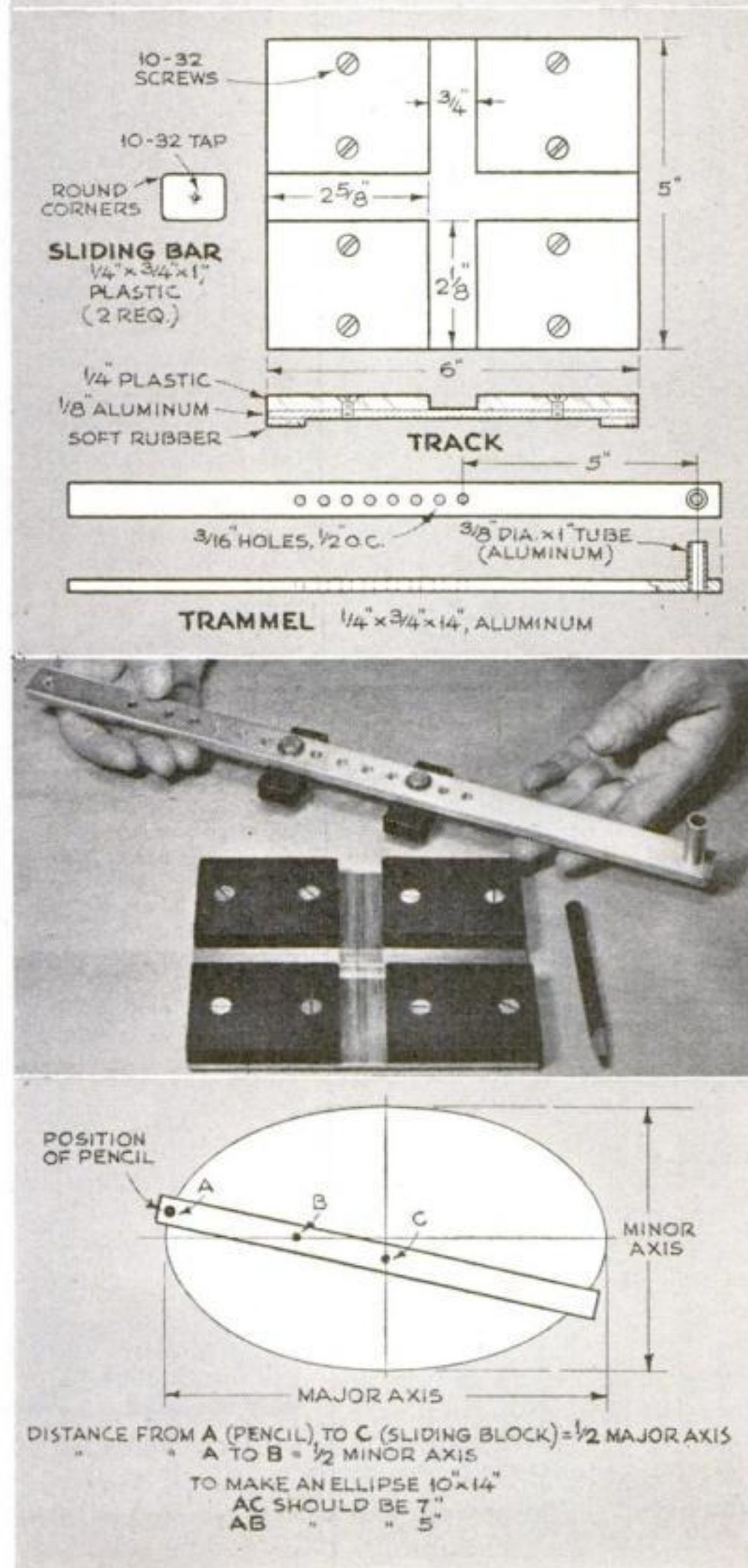
DRAWING an ellipse with a thread and pins is far from ideal in a machine shop. The most accurate mechanical method is with an ellipse trammel and track. You can make your own.

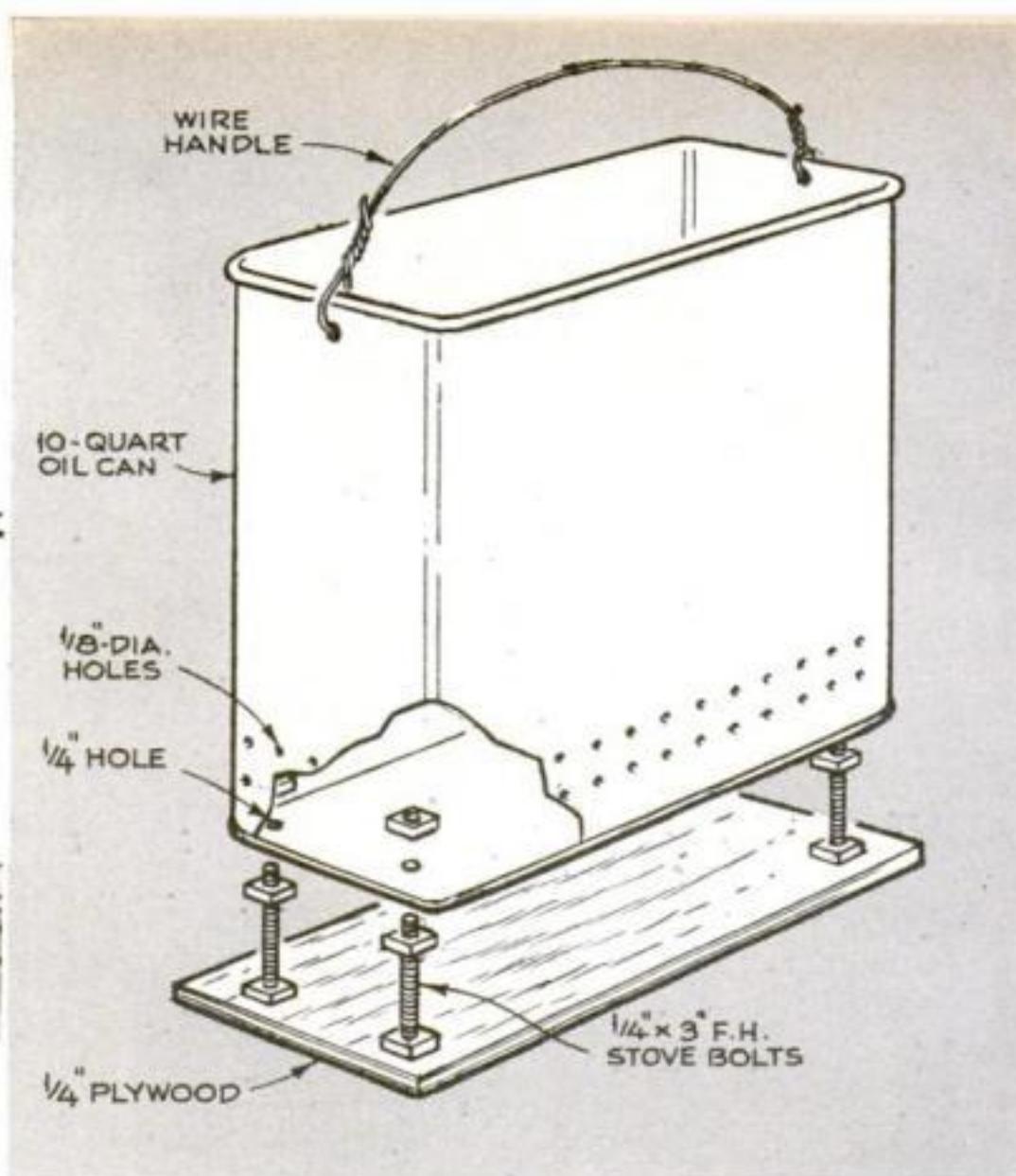
The principle is easily understood once you see the sliding bars move along the major and minor axes and the ellipse begins to take shape. There is no specific size for the track, but track size does limit the size of the ellipse. The one I use most frequently is shown. The track was made from plastic, the base from $\frac{1}{8}$ " aluminum—but $\frac{1}{4}$ " plywood will do as well if sanded smooth and square.

When assembling the four pieces on the base, make certain that the two sliding blocks do not bind and that the track is perfectly square. For an accurate ellipse there should be very little clearance. Glue four rubber pads on the bottom of the base to prevent sliding.

The trammel is made from an aluminum bar $\frac{1}{4}$ " by $\frac{3}{4}$ " by 14" long. In one end, drill a hole for a $\frac{3}{8}$ " aluminum tube. A piece cut from a TV antenna is just the right size for a pencil. About 5" away from the pencil hole drill a series of $\frac{3}{16}$ " holes $\frac{1}{2}$ " apart. These are clearance holes for the 10-32 screws and should be a good fit.

When the trammel is assembled, it should have a nice easy sliding movement in the track. A flat washer between the aluminum bar and the two sliding bars will help prevent rubbing against the track. Other holes can be drilled if necessary to obtain various size ellipses.
—Robert Micals, Freehold, N. J.

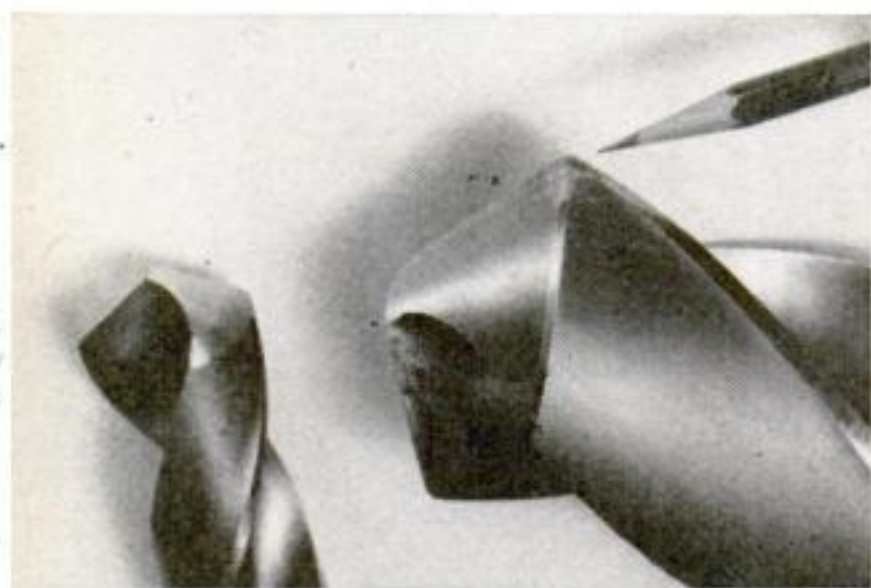




Portable warmer for winter sports

Here's an easily made portable warmer to keep you comfortable this winter while engaging in such sports as skating, sledging, or ice fishing. Drill or punch a double row of holes near the bottom of a

large motor-oil can and cut out the top, leaving no sharp, jagged edge. Stand the can on stilts as shown—four bolts through a plywood base. Fill a third full of charcoal, pour on starter fluid, drop in a match—and you'll have heat for several hours.—Roy A. Cox, Muskegon, Mich.



Radius on drill gives smoother finish

Want to improve the finish of holes drilled in metal? Grind a small radius on the two corners where the conical point and drill body meet. In addition, I finish these radii with an oilstone, for the better the finish the smoother the hole the drill will make. Be sure to maintain the same relief angle (from cutting lip to heel) that is always necessary for free cutting.—H. J. Gerber, Menomonie, Wis.

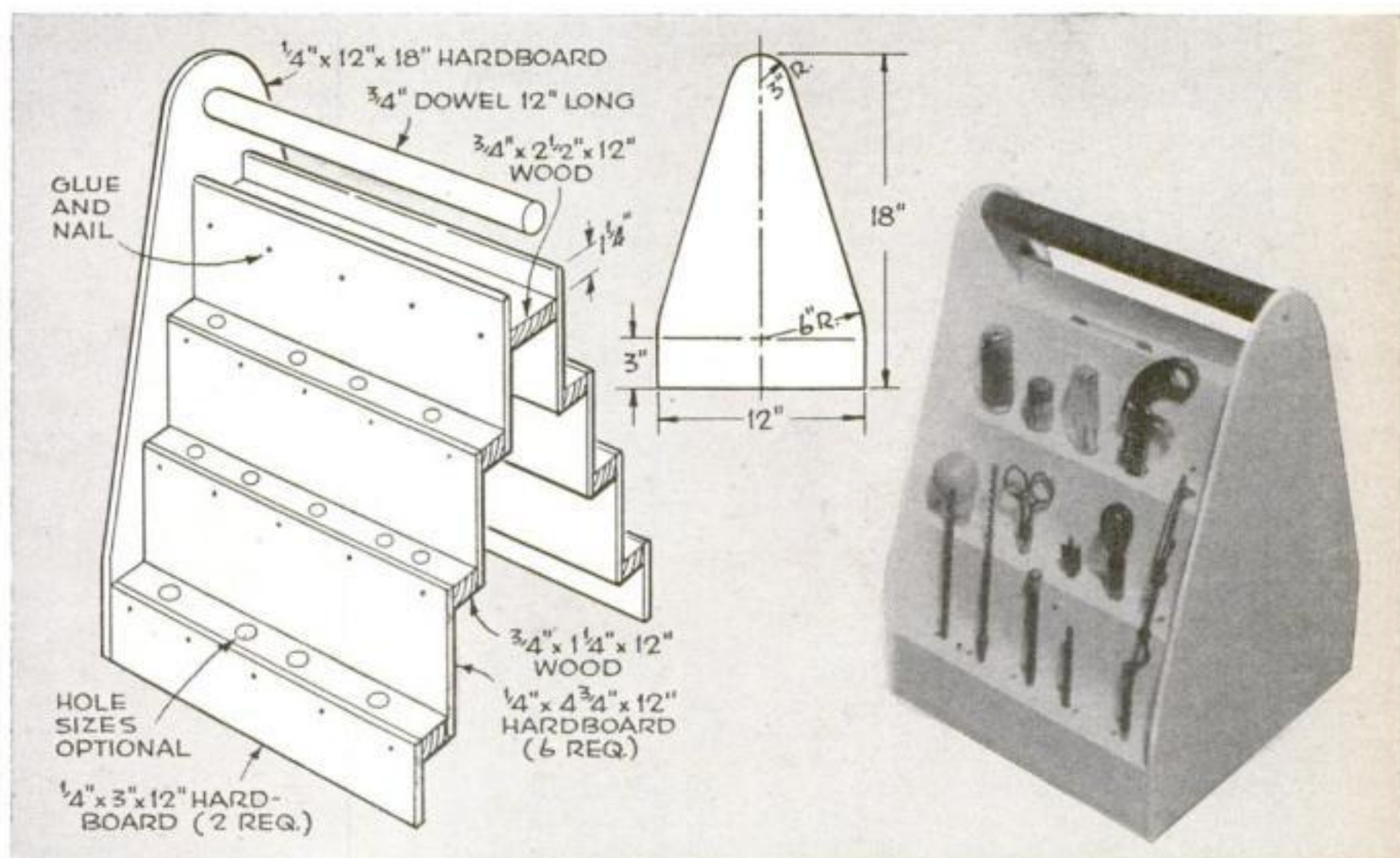
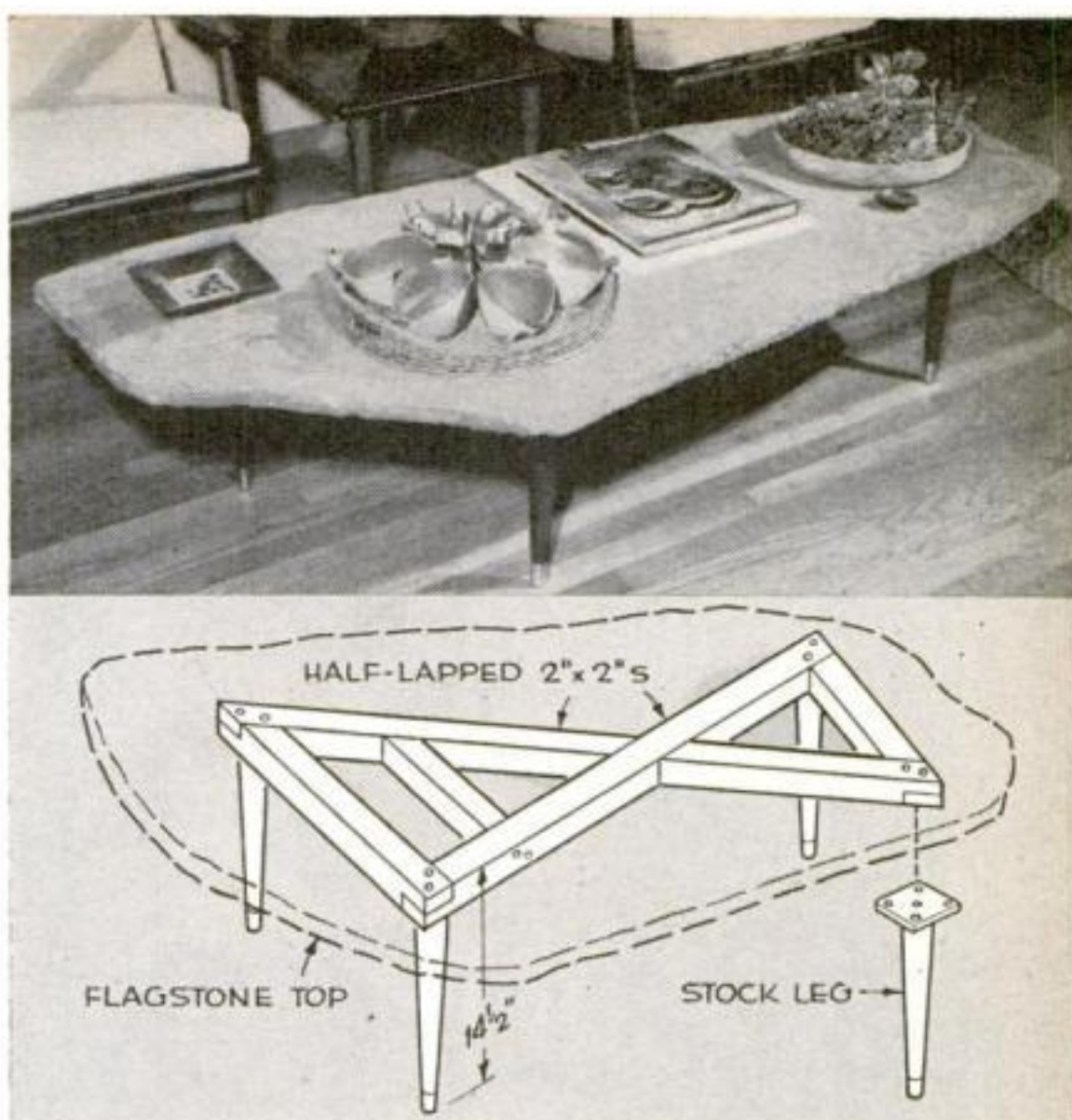
Side-cutting drill makes slots

Grind a series of shallow grooves along a twist drill to break up the flute edges into a series of teeth, and you have a tool for making slots in wood and other materials. Stagger the grooves so the teeth on one flute remove ridges left by notches of the preceding flute. Grind the bit to produce greater relief for the teeth. The bit should be rather stubby, the better to withstand side pressure. A cross-feed (milling) table attachment on a drill press is the best way of feeding work to such a bit.—Walter E. Burton, Akron.



Flagstone table—beauty with a rugged look

A textured-flagstone slab resting on a framework of two-by-twos makes a simple and handsome coffee table. Any reasonably flat stone may be used. If you wish angled legs, mount them on blocks cut on the slant. For use outdoors, all the wood parts require sealing with exterior paint or varnish.—*Hi Sibley, Nuevo, Calif.*



Carry-all tool holder goes to the job

This compact tool holder has space enough for all the tools you need in general home maintenance, puts them on display so you can drop your hand instantly on the one you want—and lets you carry them all to the job. The sizes of the holes, and the dimensions and number of shelves, can all

be varied to suit your particular needs.

The holder shown was made of hardboard and lumber. Shelf bottoms and hardboard risers are fastened with wood glue and $\frac{3}{4}$ " clincher nails spaced 4" o.c. End panels are secured to the wood shelves with $1\frac{1}{2}$ " twist nails. Wood screws would do, too. Two coats of paint—a primer and a finish coat—complete the job.

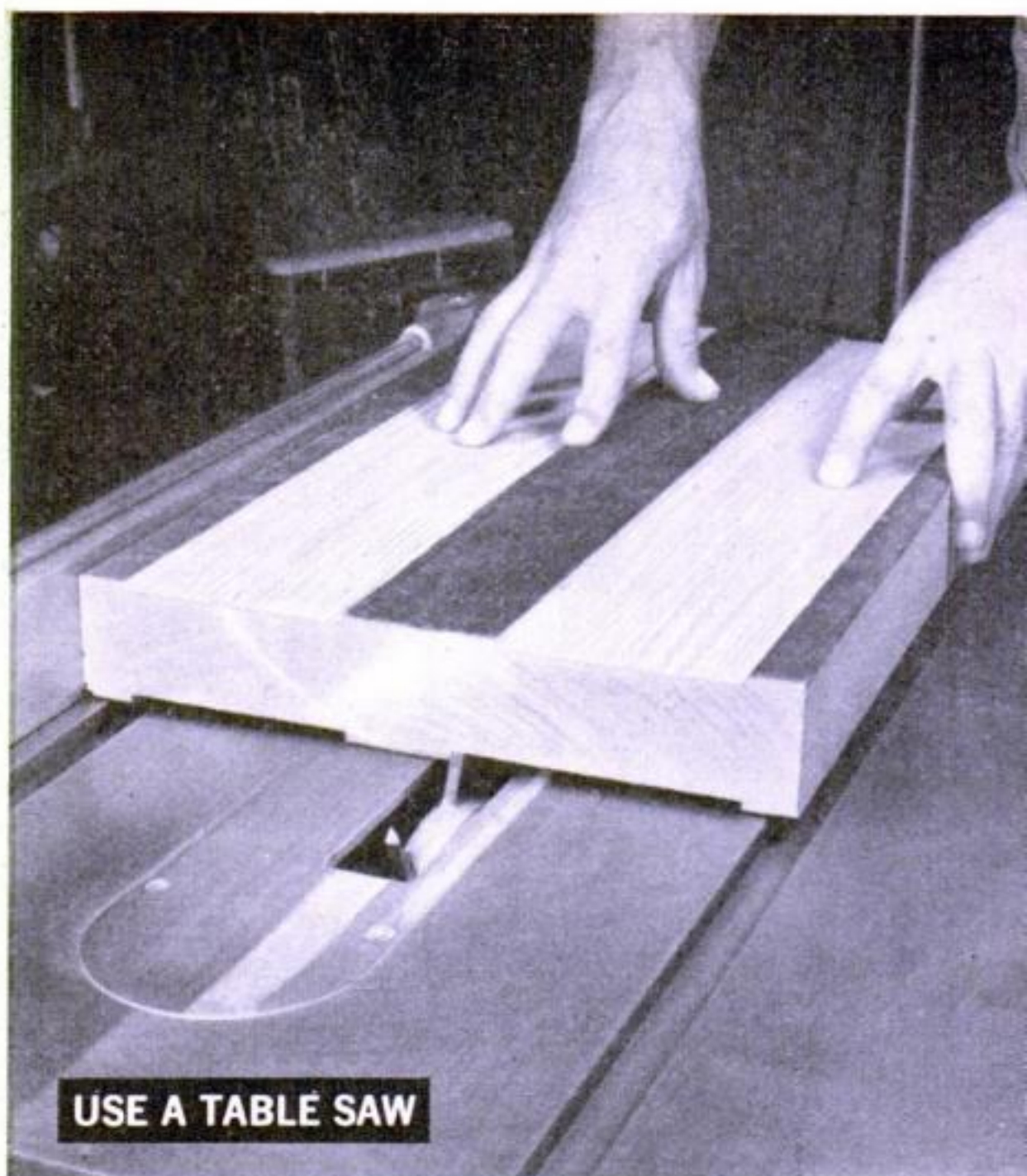
How to Be Happy Without a Planer

Often you can use a tool you already have when you want to surface rough wood or reduce its thickness

By R. J. De Cristoforo

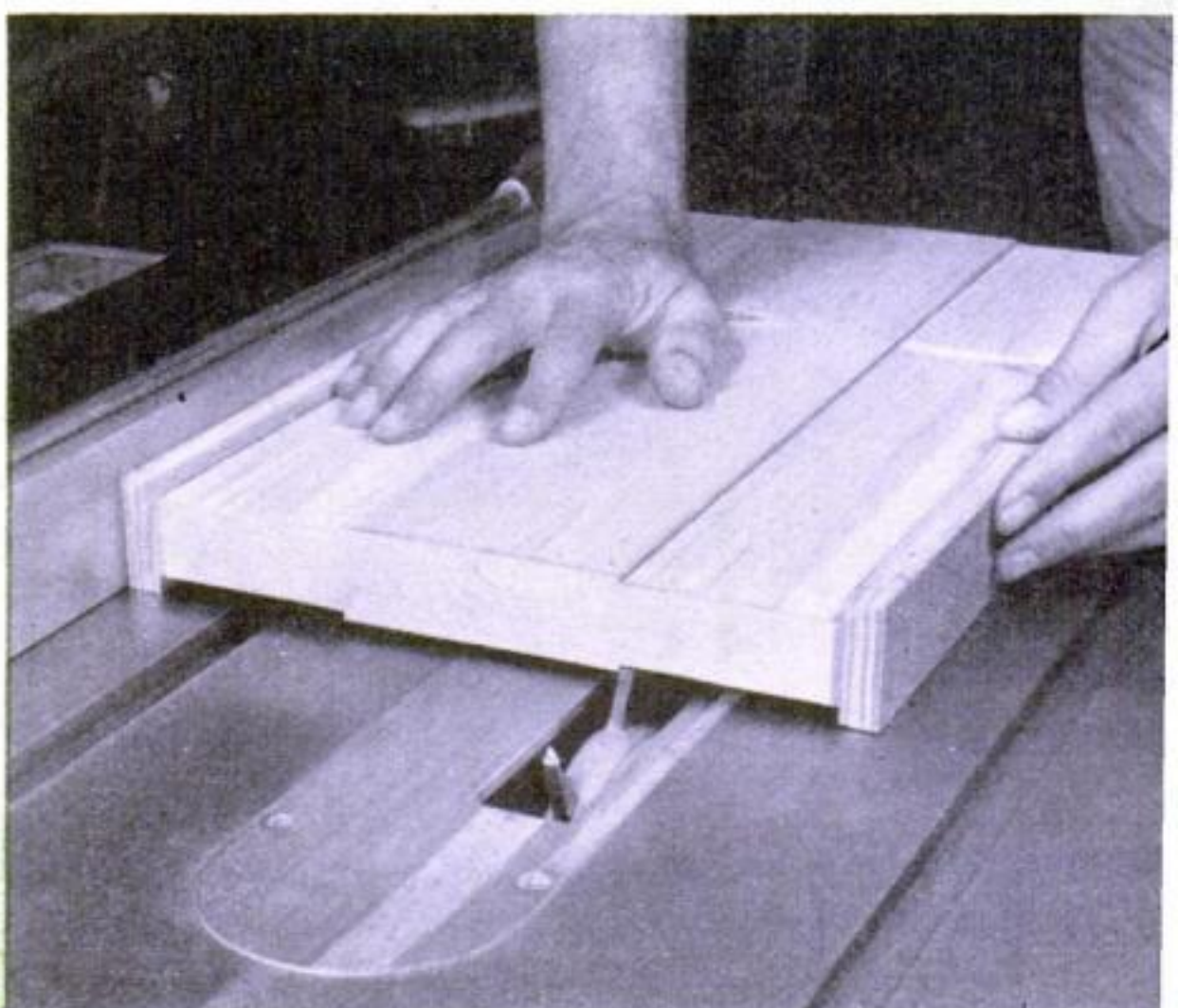
THE thickness planer is a beauty of a tool, but cost keeps it out of most small woodworking shops. Usually you can get along without one since surfaced lumber is as available as your nearest lumber yard. What do you do, however, when you *do* want to accomplish thickness-planer operations? Answer: Use the tools you now own.

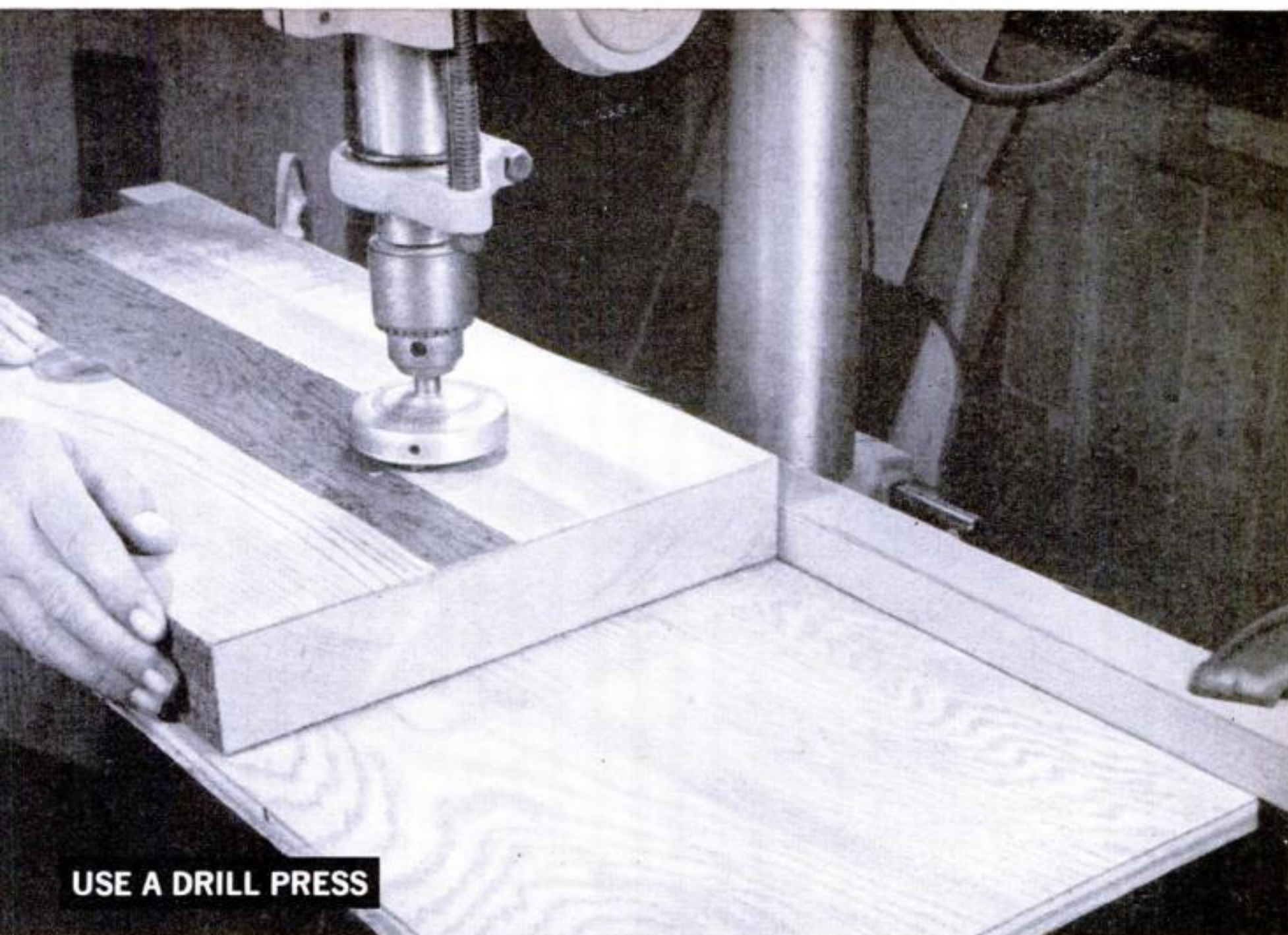
A circular saw or bandsaw can be used to make thin boards out of thick ones. The table saw—with a good dado, or molding head equipped with blank knives—will do an acceptable job of surfacing, even to making distorted stock usable. A rotary head on a drill press will do a fast, clean job of



USE A TABLE SAW

A dado cutter, or a molding head with blank knives, will do a fine surfacing job if you overlap the passes slightly. Where stock is fairly uniform to begin with, leave edges uncut to serve as supporting rails, as above. On warped stock, nail strips to edges to form separate rails, as below. Make two passes on each side of the work at each fence setting.



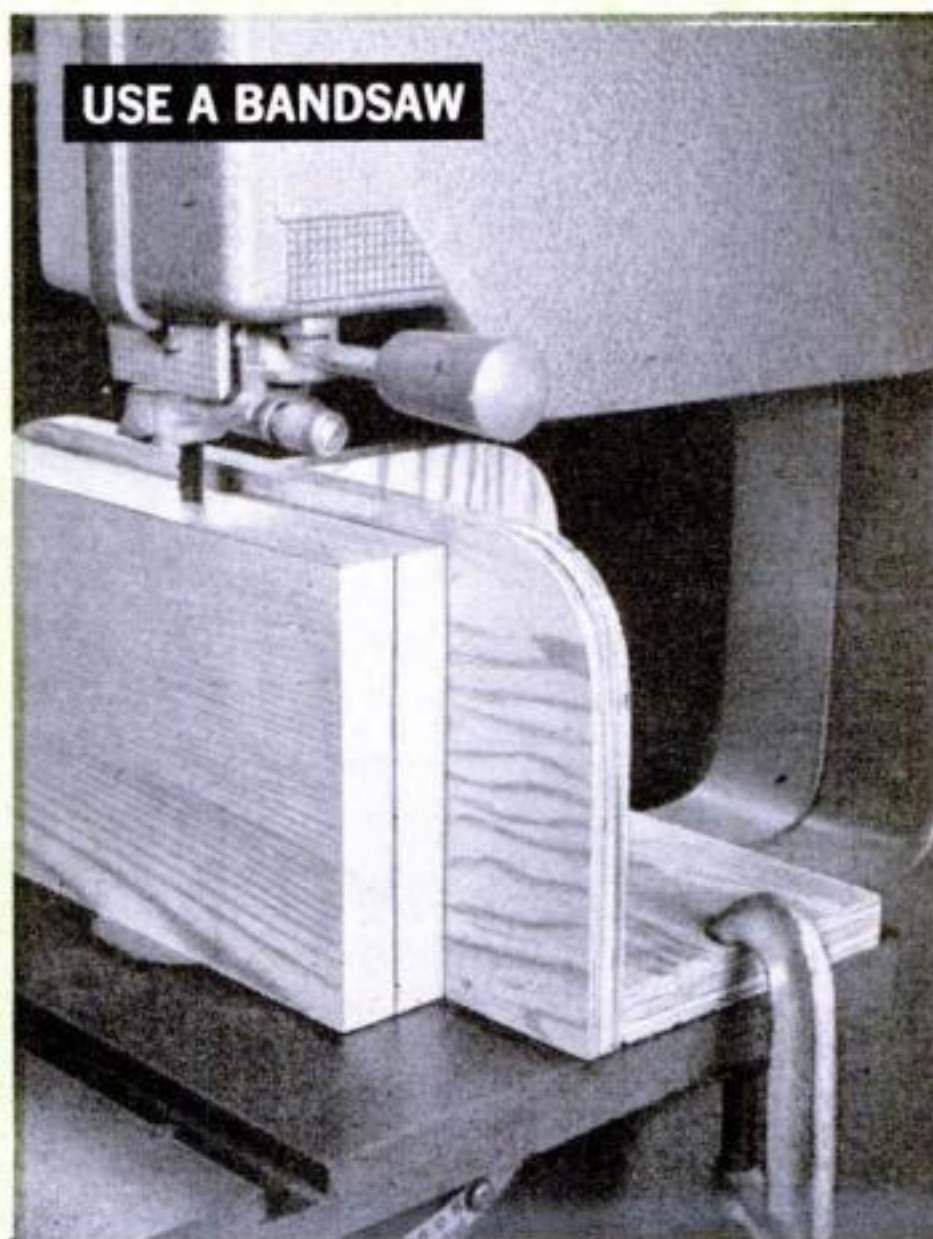
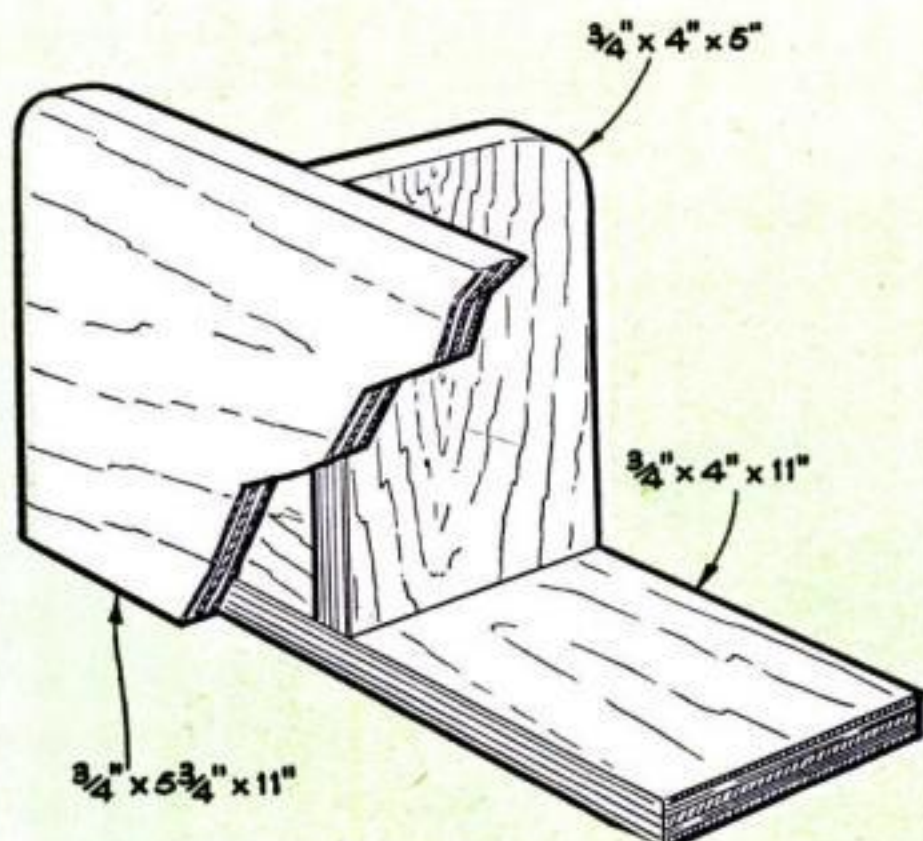


USE A DRILL PRESS

Rotary planer can be used in a drill press or radial-arm saw. Stock can be warped as long as it lies steady and doesn't rock. Plane off

one side, flop the work to get the other side parallel. On large stock, use an auxiliary table with a guide fence clamped to it.

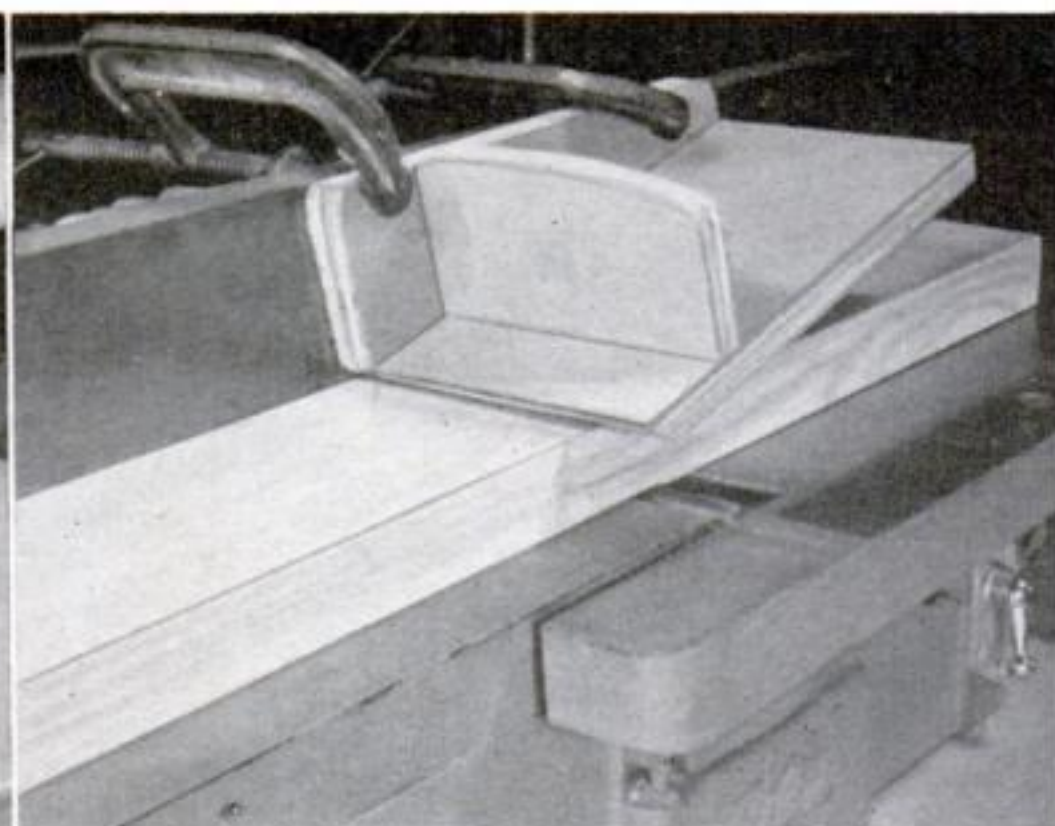
Sawing off the rough face of a board on a bandsaw is a good, fast method. Make a high, wide fence, such as the one below, and clamp it to the table to support the stock. Use a wide blade and don't force the cut. Finish off with sanding if you want a smooth surface.



USE A BANDSAW



USE A JOINTER



You can surface on a jointer if stock is reasonably uniform. Most important: Keep the work flat. On short pieces, you can use a hand-held hold-down, as above. Long pieces require a

rigid hold-down clamped to the fence, as at right. Leading edge is beveled and rides on work just above the cutter. Keep the pass continuous; stopping will result in a gouge.

surfacing and can also be used for stock reduction. Even a small jointer (which is not basically a surface planer) will do a creditable job if care is observed.

Table saw. To surface a rough board or simply reduce thickness, you can use a dado assembly that has been properly jointed to cut a flat-bottom groove. Or you can use a moulding head fitted with blank knives. In either case, you make successive cuts, with the work riding the rip fence. Depth of cut depends on whether you want to reduce thickness or are surfacing.

If the board is reasonably flat to begin with, you can work with it as is, leaving narrow, uncut strips along each edge to serve as rails for the work to ride on. If the board is warped, you provide the rails by nailing strips along the edges. The

strips are a little wider than the thickness of the stock so the work surface is elevated just a bit above the table surface.

How wide a board can you handle on the saw? It would have to be an awfully small machine not to handle 12" stuff.

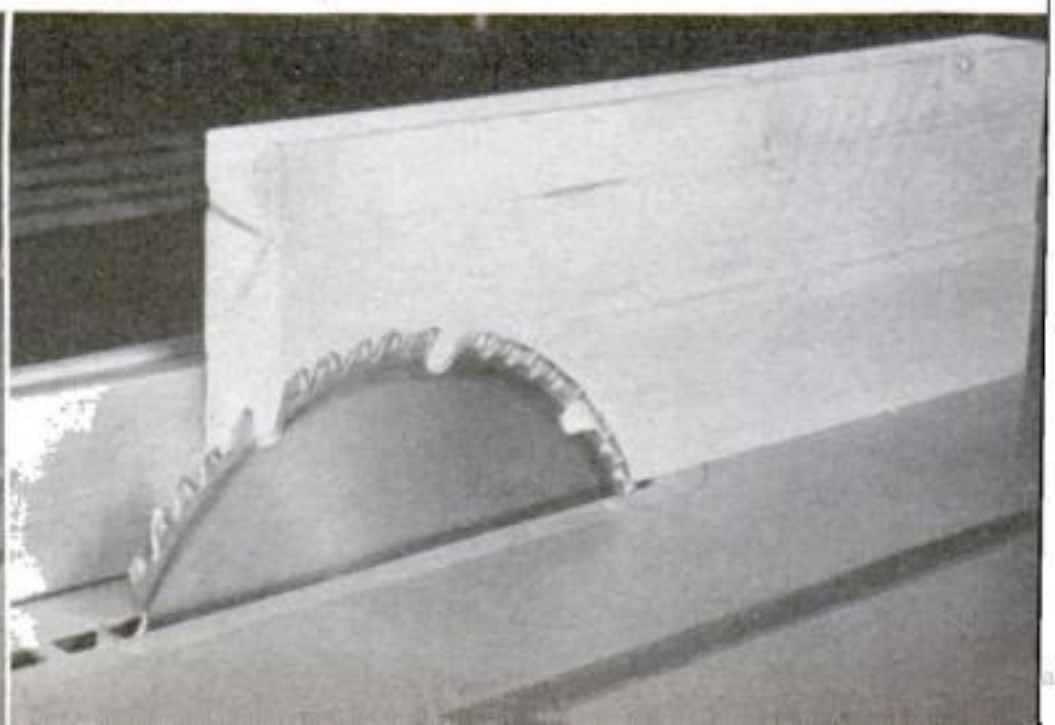
The drill press. Equip it with a rotary planer, and you have a surfacing tool. It works best between 5,000 and 6,000 r.p.m., but can be used successfully at 3,000 to 4,000. At lower speeds use a slower feed to compensate. The action of the knives in the head is essentially shearing and scraping so sharpness is important for a quality cut. But since the cutters are easy to remove and grind or hone, this is a problem only if you neglect the chore.

Be sure the chuck is tight on the spindle and that it is equipped with a safety collar.

Two more smoothing jobs you can do on a table saw

Splitting one board into two gives you two flat surfaces. On wide boards, saw halfway through from each edge. If you still can't cut all the way through, finish up with a handsaw.

When both sides must be parallel, it's best to follow the surfacing cut made on a jointer with a pass through a table saw. Most often a light, shaving cut is all that's needed.



If your chuck lacks this, it's wise to use a safety-collar-equipped adapter for mounting the planer.

Keep the work flat on the table when moving it. Since the cutter is overhead, it will dig in if you raise the work during the pass.

The center boss on the planer provides a good visual check for depth-of-cut control on light cuts. If the work has high spots, reduce these first until a final setting of the planer (by extending the drill-press quill) hits all areas.

A drum sander works well on a drill press for surface sanding and even for stock reduction if you don't mind a series of dust-producing cuts. But you do need a small adjustable jig that will permit passing the work between a fence and the drum. This is not intended as a heavy-duty operation. Keep cuts light; if much stock must be removed use successive passes.

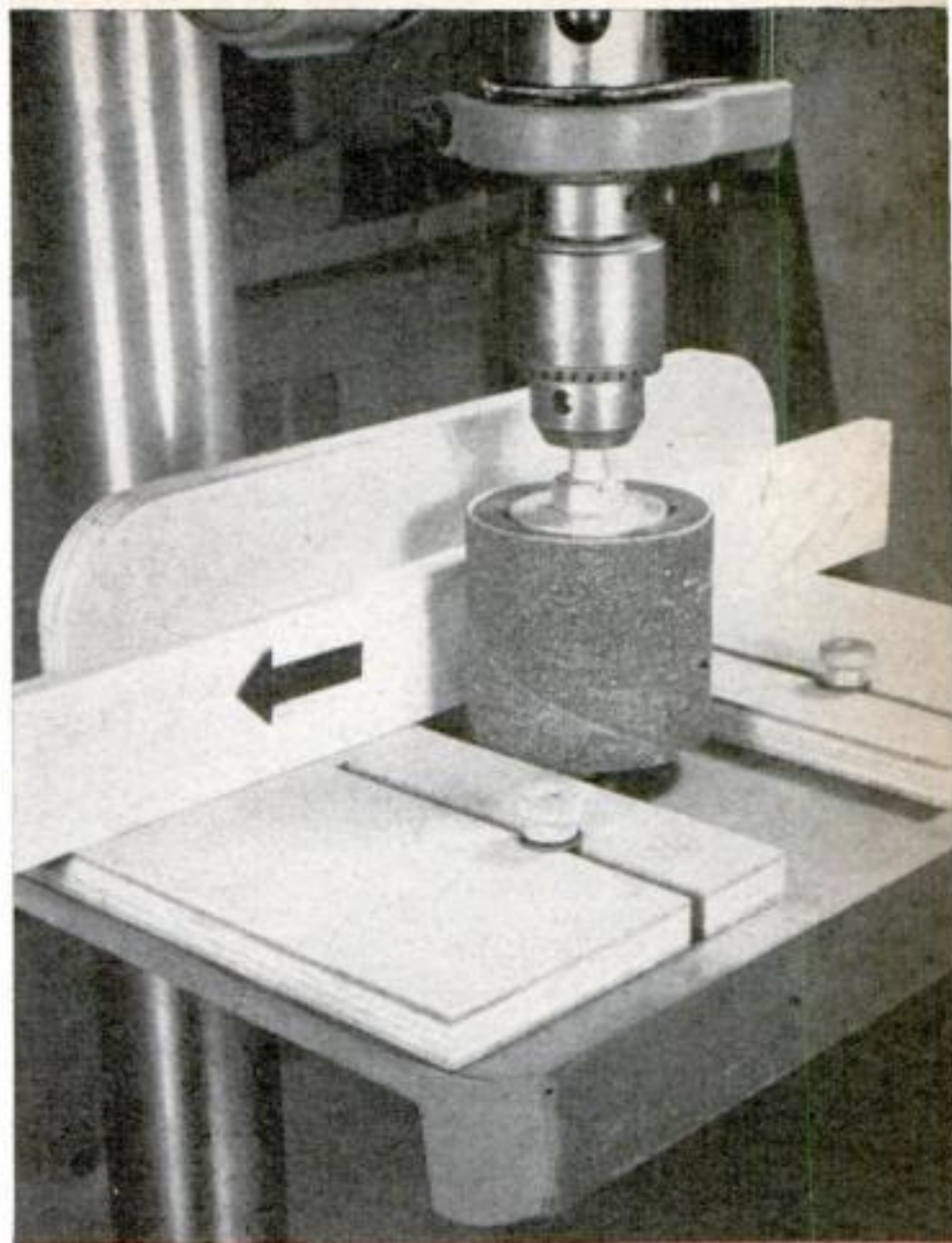
Jointer. You can plane a surface with a jointer, but there's no guarantee that opposite surfaces will be parallel. Best bet when this is the goal is to plane one surface and joint one edge; then rely on the table saw to reduce the opposite surface. This works best when the stock is within the limits of the jointer size and no more than twice the maximum depth of cut of the saw.

On long stock you need some sort of hold-down to keep the work snug on the outfeed table just aft of the knives. Commercial spring hold-downs or homemade spring sticks can be used when the stock is not too uniform.

On boards wider than the jointer can handle, you can plane the surface in two passes. The first cut is like forming a very wide rabbet. Then the work is turned end-for-end and a second pass made. On one cut you will be working against the grain and the surface may not be so smooth. But keep the cut light (a good idea for any kind of surfacing) and feed slowly.

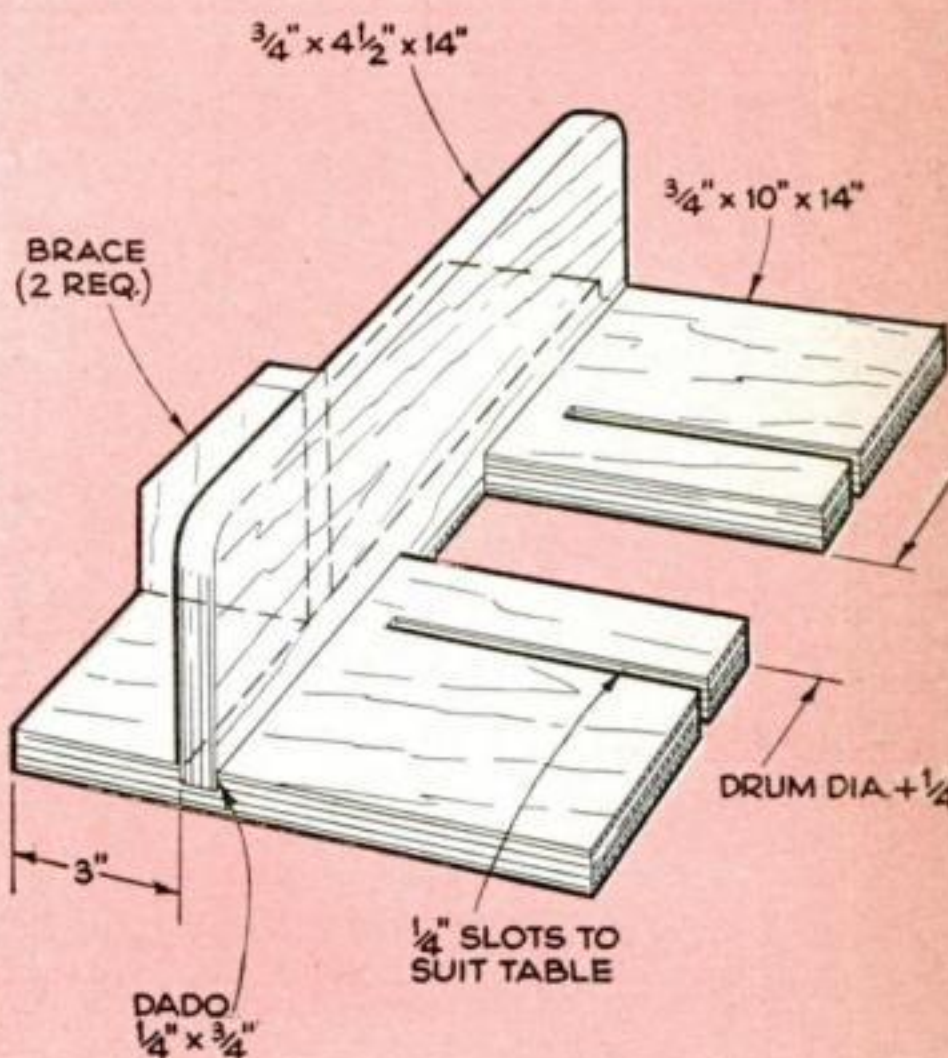
Bandsaw. This is not a surfacer, but it's the tool for resawing since it cuts so fast. Trouble comes when you try to force the cut—push the work through faster than the teeth can handle it. The blade will “bow” in the cut where you can't see it—and one cut surface will be concave, the other convex.

Use a wide blade (at least $\frac{1}{2}$ "), a high fence as a guide, and a slow feed for good results. ■ ■



Even a drum sander becomes a thickness planer with this jig

This special jig permits accurate thickness sanding by holding the work at a fixed distance from the drum. Make it as shown below, with slots to adjust its position. Take light cuts and always feed against the direction of the drum's rotation.



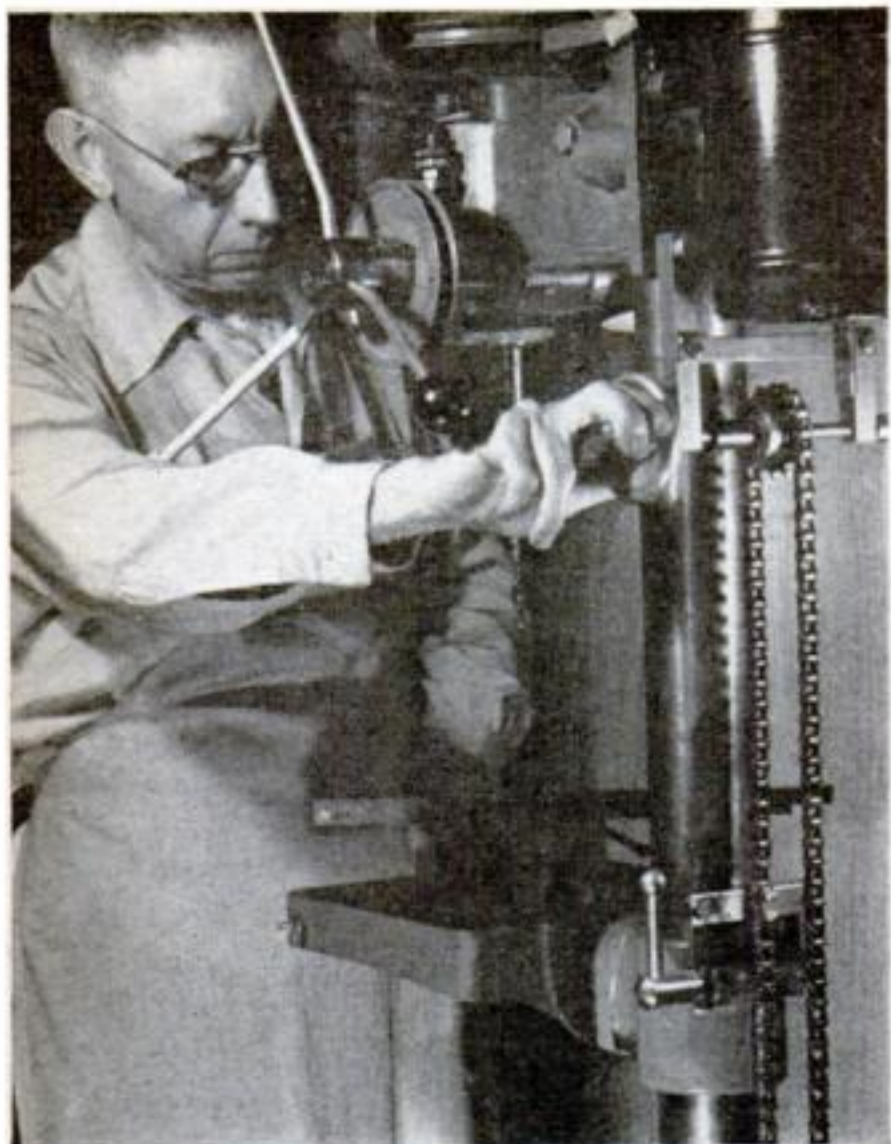
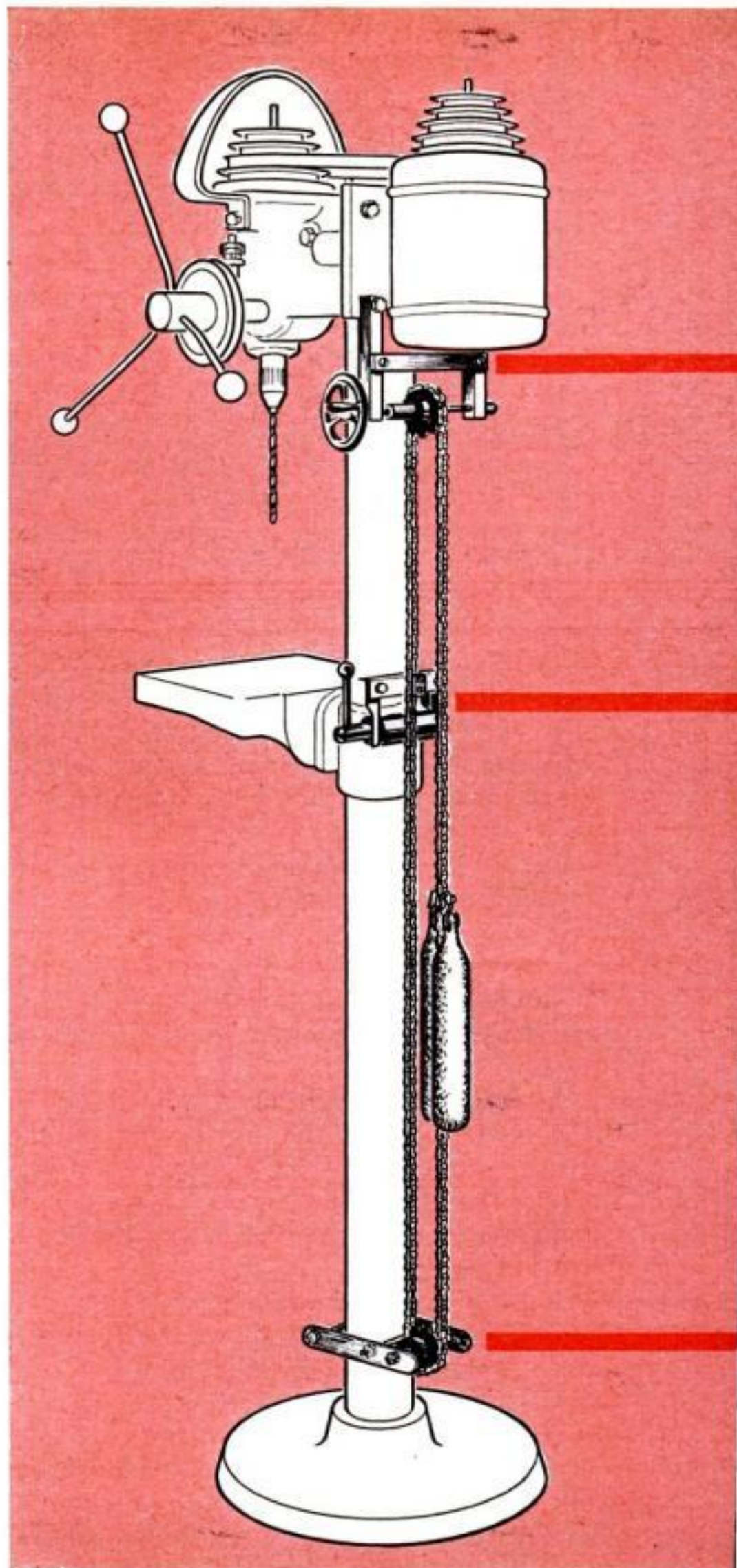


Table Hoist for a Drill Press

By Walter E. Burton

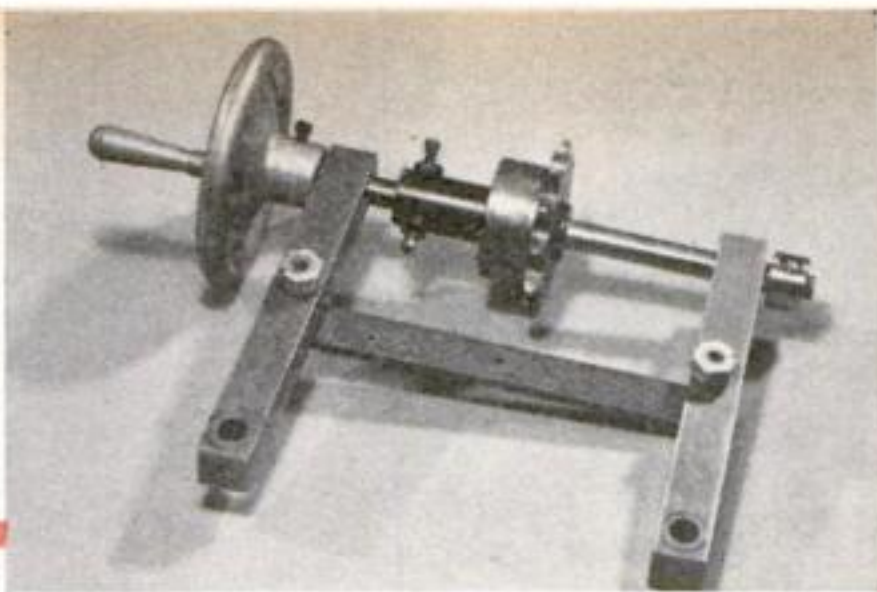
SPIN a small handwheel at the top of this drill press and the heavy table glides effortlessly up or down to the exact height you want. The elevator is simply a pair of bicycle-like sprockets with roller chain running between them to hoist the table. Weights attached to the chain counterbalance the table so that it moves in either direction with equal ease.

The rig can be adapted to any drill press by adjusting the dimensions. The upper sprocket turns in a bracket held by the motor-mount bolts. The lower sprocket is mounted in a yoke clamped around the base of the drill-press column. The drill-press table is fastened to the chain by a bracket that straddles the table's split collar. With the table lock loose, the table is free to ride up or down with the chain. At the desired height, a

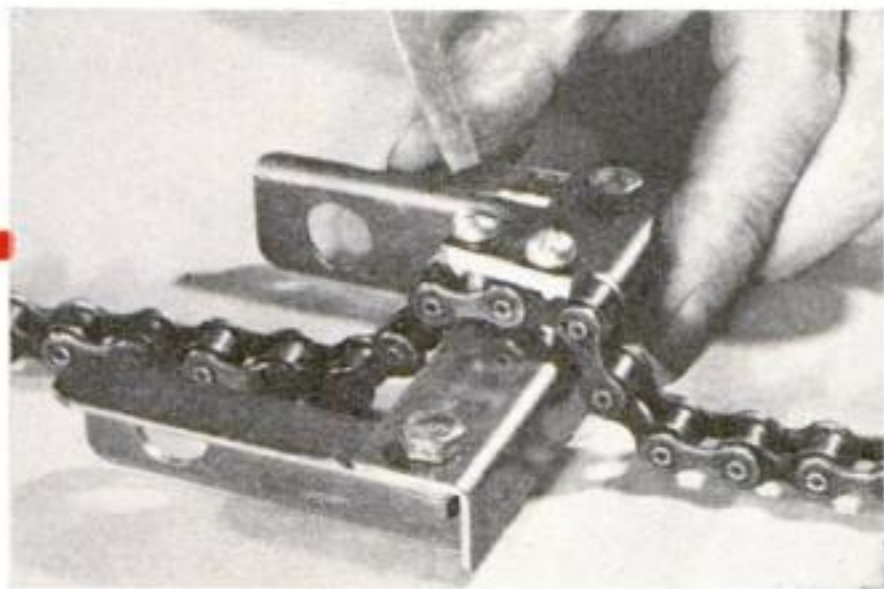


turn of the lock clamps the table rigid for use.

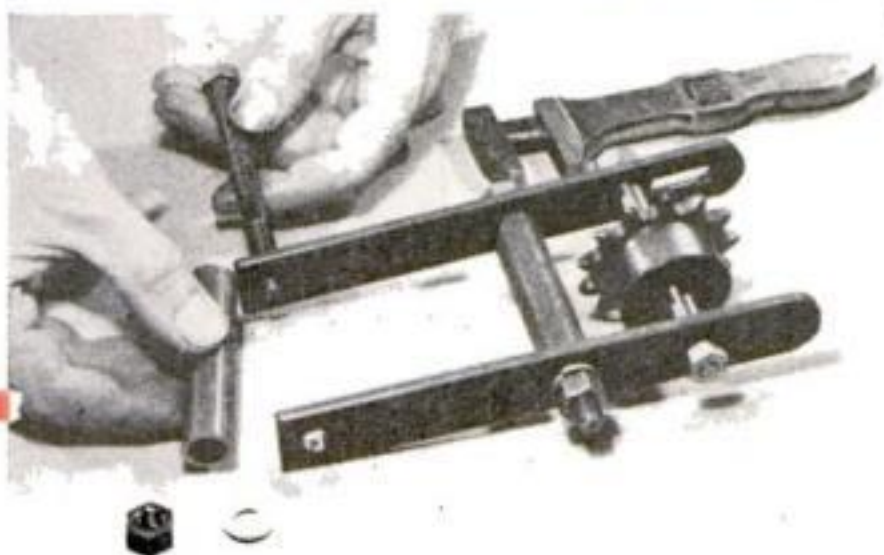
I used industrial sprockets and chain because they were handy, but standard bicycle parts will do nicely. Exact size isn't important so long as the sprockets and chain are of matching design. The sprockets should be small—2" to 3" in diameter—to keep the rig compact. Those shown here have 13 teeth, $\frac{1}{2}$ " pitch, and take $\frac{1}{4}$ " roller chain. You'll need about 80" of chain



Square bars, $\frac{3}{8}$ " or $\frac{1}{2}$ " thick, are drilled at ends for shaft of upper sprocket. Other ends hang from motor bolts. Shaft is held in place by handwheel and by collar on other end.



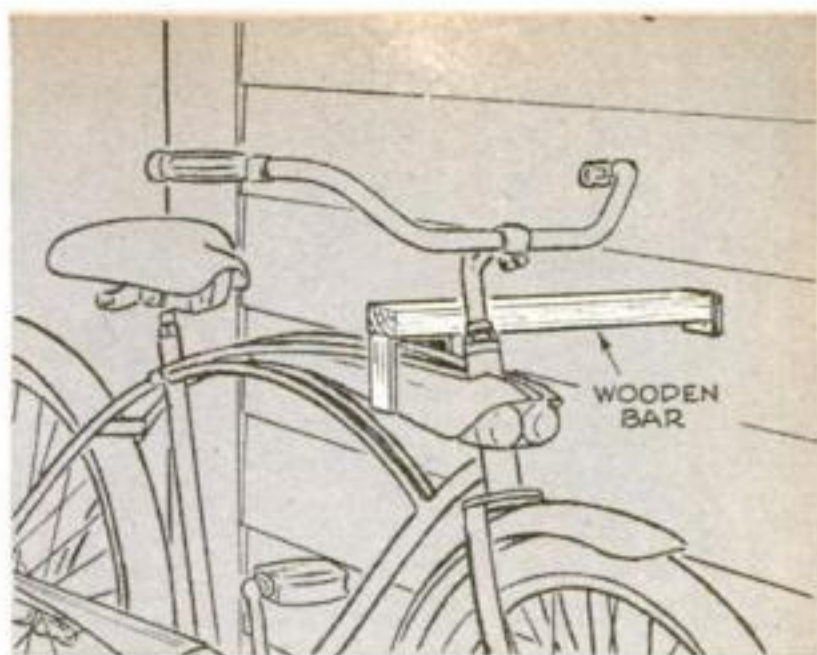
U-shaped bracket, made of steel angle, hooks over the table's locking bolt to anchor the chain. The chain is bolted to the bracket with a metal bearing plate under the bolt heads.



Lower sprocket is held in yoke made of two lengths of 1" steel strap. Two bolts clamp the yoke around the drill-press column. Sections of pipe slipped on the bolts act as spacers.

if you have a full floor-model drill press.

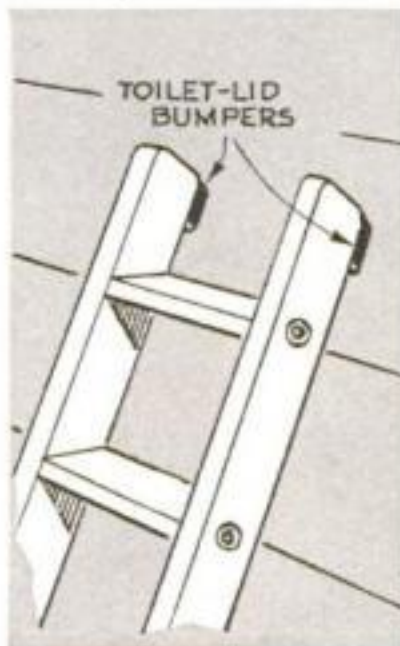
For the counterweight, you can use a couple of window-sash balance weights, a container filled with sand, or any other heavy object you have around the shop. The holes in the chain make it easy to attach the weight with hooks, wire, or bolts. It's best to weight the chain a little heavier than the table, to allow for the weight of work placed on the table.



Hinged wooden bar supports bike

A piece of wood 1" by 1 $\frac{3}{4}$ " by 18" fastened to the side of the house with a hinge is a handy support for my son's bicycle. A U-shaped piece of metal at the outer end drops over the top bar of the bike. The support keeps the bike upright and makes it easy to cover with a plastic sheet.—P. T. Burch, Albany, N.Y.

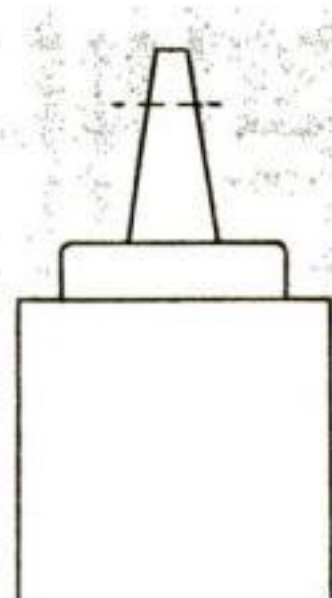
Bumpers on ladder protect siding



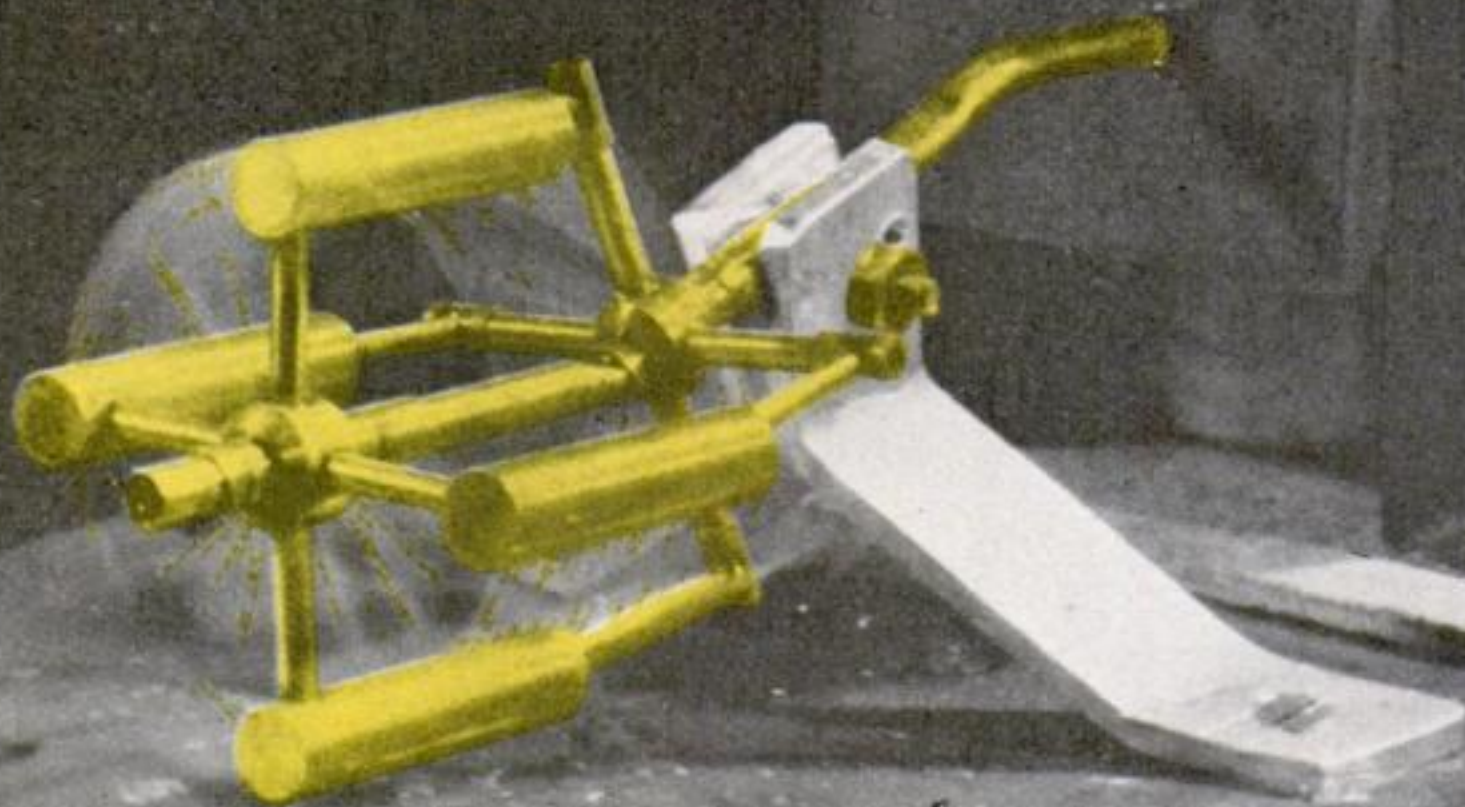
Here's a simple idea I'd like to share with other readers: To keep a ladder from scuffing the side of a house, attach rubber toilet bumpers at the top of each side rail. They're cheap, come with screws.—L. Nickel, Palo Alto, Calif.

Plastic dispenser for roof cement

When you're applying light-colored asphalt shingles, the appearance is ruined if black cement gets on the exposed surface. To avoid this, I flow on the cement from a plastic mustard or catsup dispenser with a shortened tip. The cement flows easier for filling if the original container is placed in hot water a few minutes.—A. W. Gunther, Hanover, N.J.



Look: An Orbital Steam Engine!



Its strange action is really out of this world

By Buford V. Frye

ORBITAL is the word for this unusual steam engine. The cylinders orbit around a central shaft, and it looks like something from outer space.

As a conversation piece, it has these points to talk about:

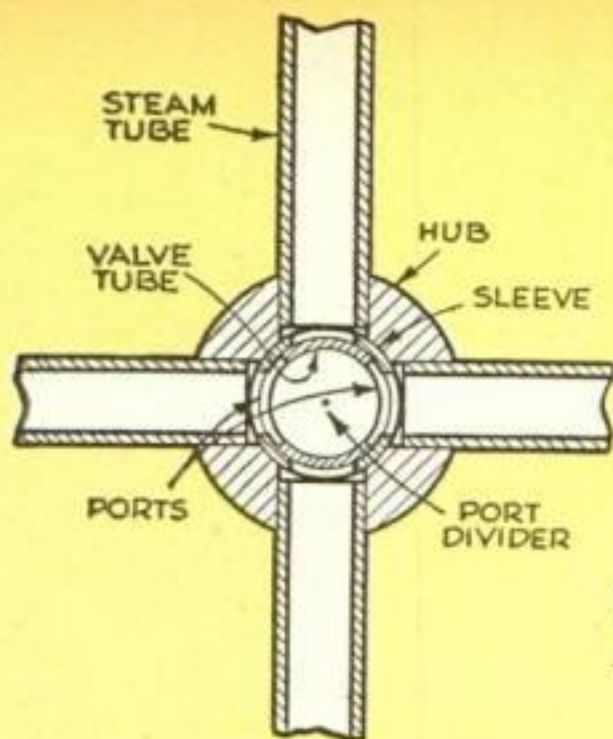
- It's self-starting from any position, with no dead center.
- The cylinders act as a flywheel.
- Linear piston motion is translated into rotary without conventional cranks, cams, or gears.
- One valve times intake and exhaust for all four cylinders.
- Piston impulses overlap, giving enough smooth power to drive a small boat, generator, or other working model.

You can build the engine in a few evenings or a weekend. Although it can be a

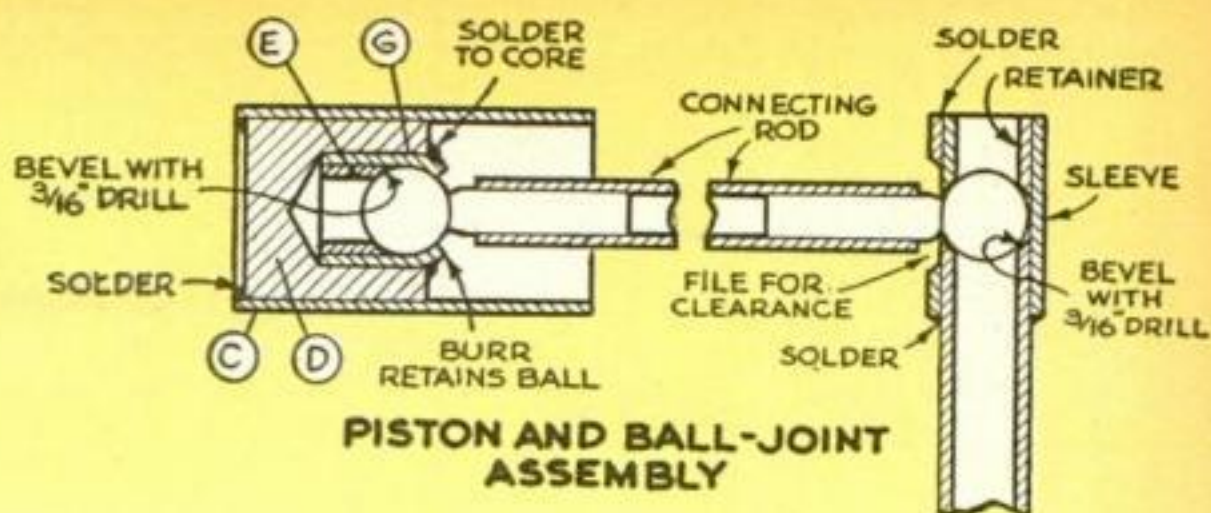
lathe job, a lathe isn't actually needed; an electric drill or drill press serves for what turning has to be done.

What makes this possible is telescoping brass tubing, in sizes $1/32''$ apart, each a close sliding fit in the next larger tube. This tubing can be bought at hobby shops or by mail. One source is America's Hobby Center, 146 W. 22nd St., NYC 11. You will also need a tubing cutter, soldering iron, hacksaw, and files.

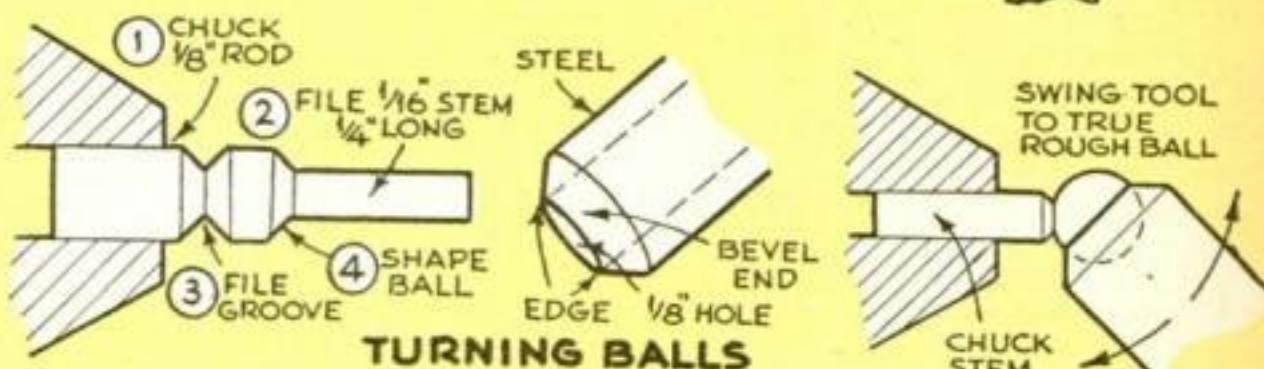
How it gets around. The engine is similar to a swash-plate mechanism, but with a four-legged cross instead of the plate. Universal ball joints link the pistons to the four crankshaft legs. The cylinders rotate around a horizontal axis, but the crankshaft cross spins on an axis at an angle to the other. Therefore when the upper leg is close to the topmost cylinder, the lower one is farthest from its cylinder.



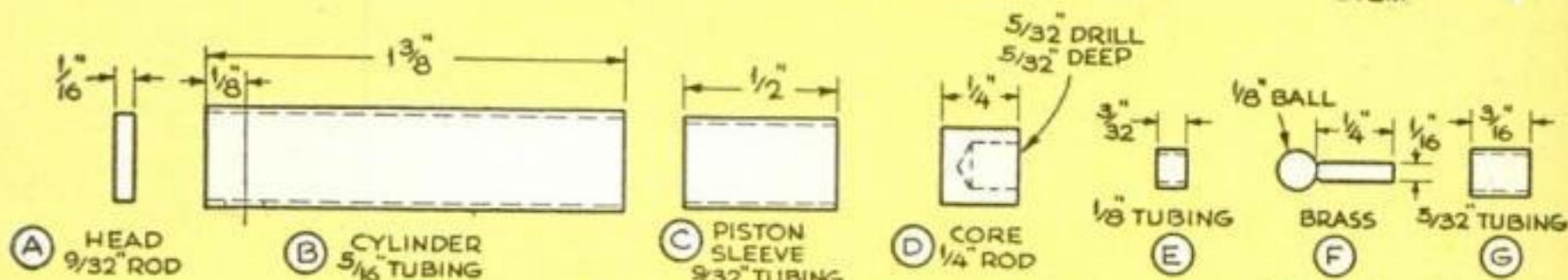
VALVE ASSEMBLY



PISTON AND BALL-JOINT ASSEMBLY

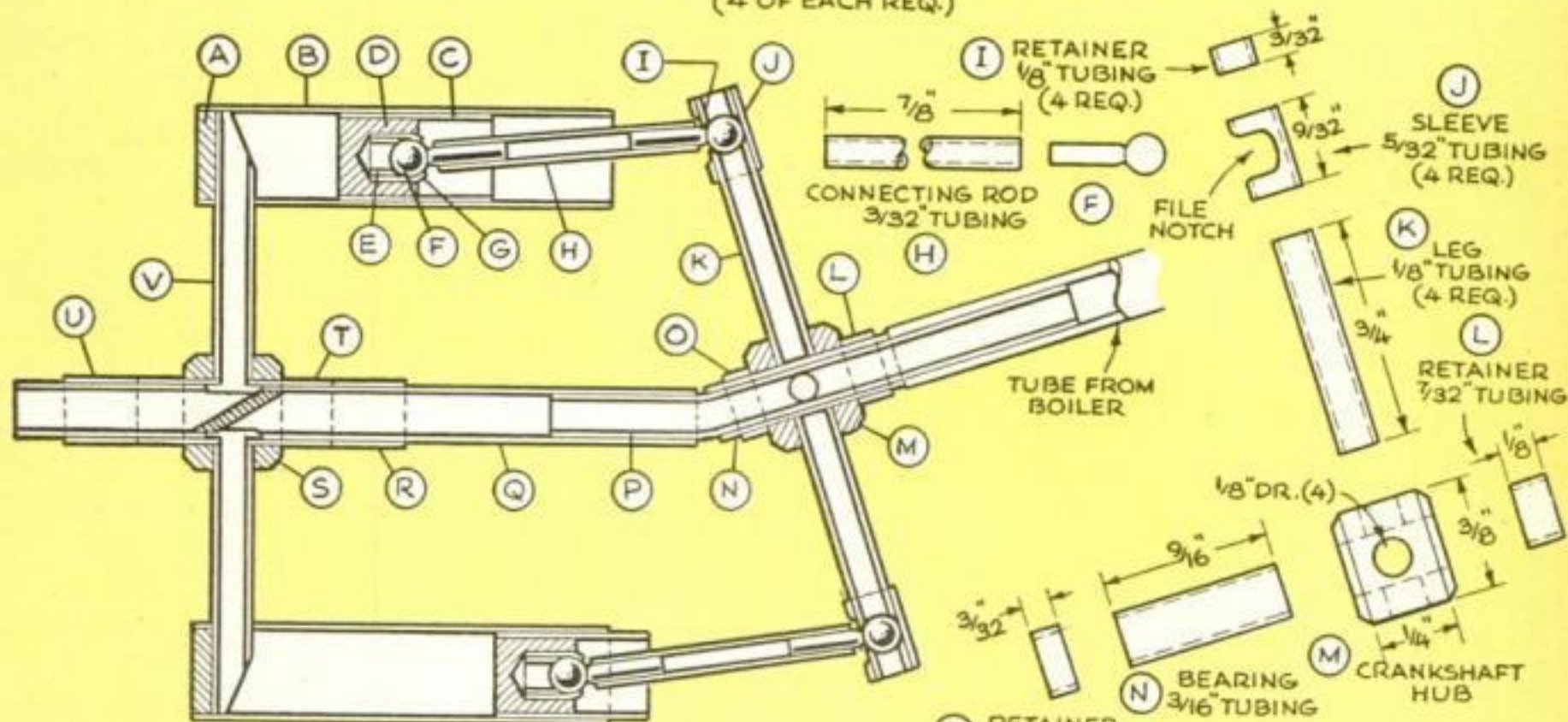


TURNING BALLS



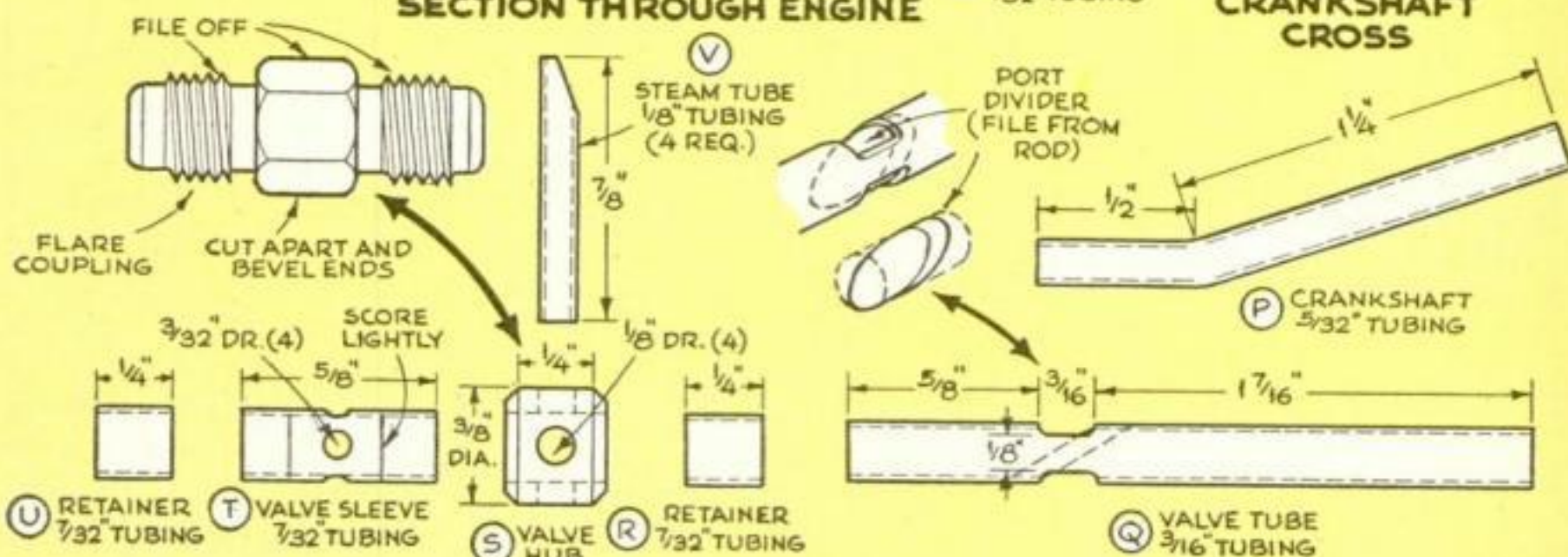
CYLINDER AND PISTON PARTS
(4 OF EACH REQ.)

BALL JOINT

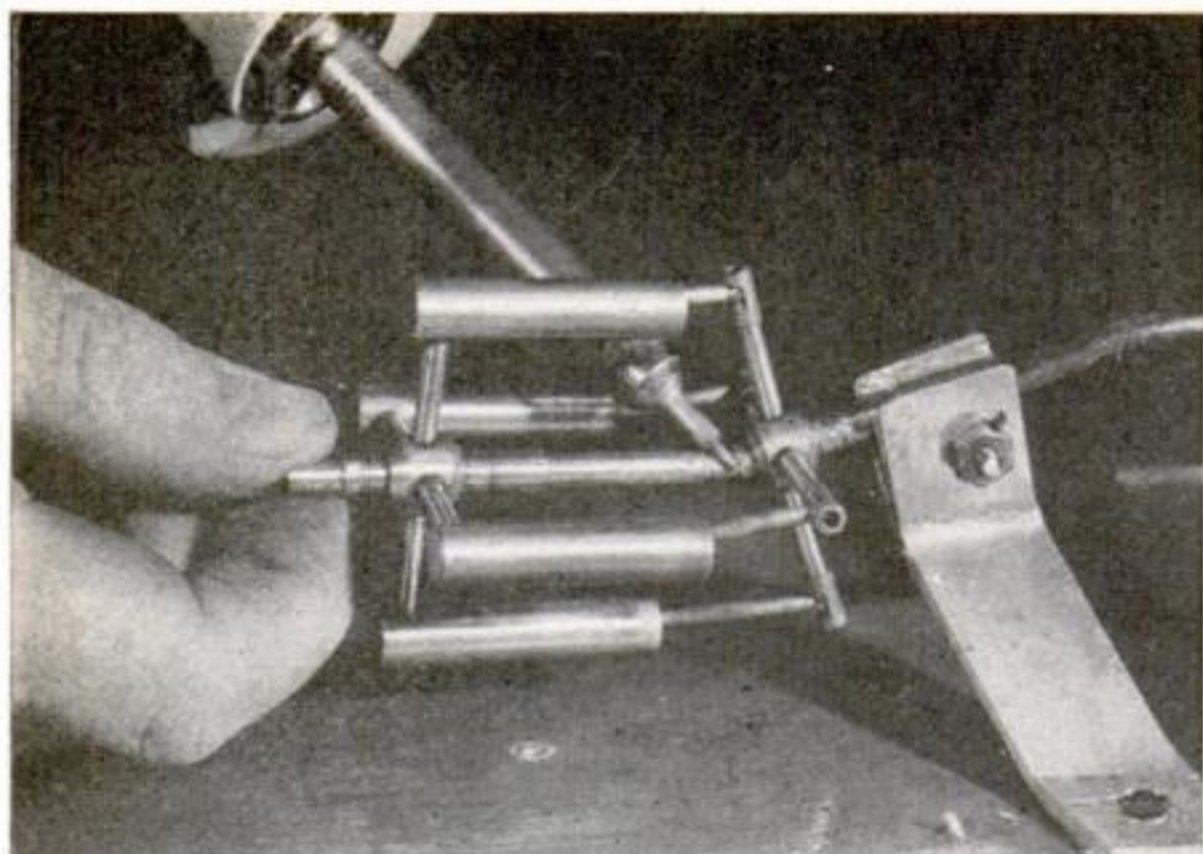


SECTION THROUGH ENGINE

CRANKSHAFT CROSS



VALVE PARTS



To set the valve timing, heat the joint as at left and rotate the valve tube (shown held at its end) on the crankshaft. For self-starting, the pistons and ball joints must work freely and timing of valve is critical.

Valve hub. Make this and the crankshaft hub from one 5/16" flare coupling, which has a 7/32" hole. Solder it to a piece of 7/32" tubing, chuck it in a drill, and file off the hex flats and threads as it spins.

As steam pushes the topmost piston out, the crankshaft leg yields by moving away, turning to a lower position. As the bottom cylinder swings toward the top, its crankshaft leg approaches, pushing its piston inward. Thus the cylinders and crankshaft cross rotate together, while the pistons move in and out in the usual way.

The valve is a stationary tube with two notches, or ports, 180 degrees apart. An oblique partition separates these ports, so that one communicates with that end of the tube leading to the boiler. The other is open to the air. Four steam tubes carrying the cylinders rotate around the ports. As each registers with the intake port, steam enters its cylinder while the opposite one exhausts through the other port.

Construction tips. The tubing cutter insures square cuts, but leaves a burr in the tubing. Ream this out with a drill or countersink before cutting the next piece. Allow about 1/64" extra length for burr removal. Do not clamp the thin-walled tubing in a vise unless you first insert a close-fitting rod to prevent deformation. When drilling holes in the tubing, start with a 1/16" pilot drill to avoid excessive pressure. Finish with a drill of the desired size.

Rotary valve. Cut the valve tube to length and file the two ports exactly opposite each other and of equal size. Leave 1/8" of tubing between them on each side. File a bit of 5/32" rod at a slant from both ends to form the port divider. Position it to allow maximum steam passage from each port to one end of the tube. Solder it in and test to make sure it's airtight.

Four holes must be spotted 90 degrees apart on each hub. This may as well be done before they are cut apart. A square-headed bolt held in with a nut may be used to index scribed lines. Saw the piece in two and file a bevel on the cut end of each hub.

Valve sleeve. To minimize leakage, push a 3/16" tube inside the sleeve and score lines around the tube 1/8" apart with the tubing cutter. The scores should be just deep enough to make the sleeve bind on the 3/16" tube.

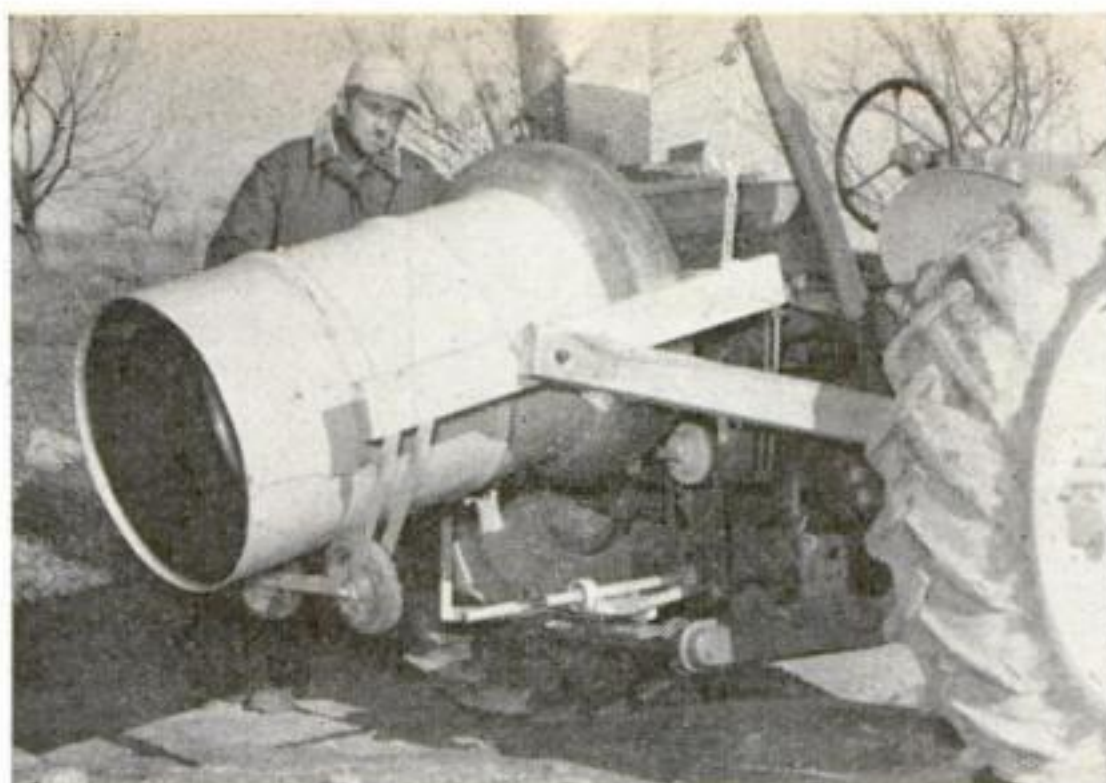
Remove the tube, center the hub on the sleeve, and tack-solder it. Drill four 3/32" holes through hub and sleeve. Remove the sleeve and enlarge the hub holes to 1/8". Then replace the sleeve, centering the small holes in the larger; solder permanently.

Cylinders. Cut four steam tubes, filing a 3/16" diagonal on each. Solder the tubes into the valve hub with the diagonals all facing one end of the hub. Cut off and deburr the cylinders. Drill a 1/8" hole 1/8" from one end of each. Slip a cylinder onto each steam tube, with the filed diagonal facing inward.

Set the cylinder heads (9/32" rod or a combination of 1/4" rod in 9/32" tubing) in place. Slide the valve hub on its tube and, holding each cylinder parallel to the valve tube, solder the steam tube and head at one heating, taking care to keep solder out of the cylinder. File heads flush with the ends.

Ball joints. Chuck 1/8" brass rod, file a 1/16" stem, and shape the ball as in the drawing. For free action, file the neck where ball joins stem slightly smaller than 1/16". A tool for smoothing the balls to size after

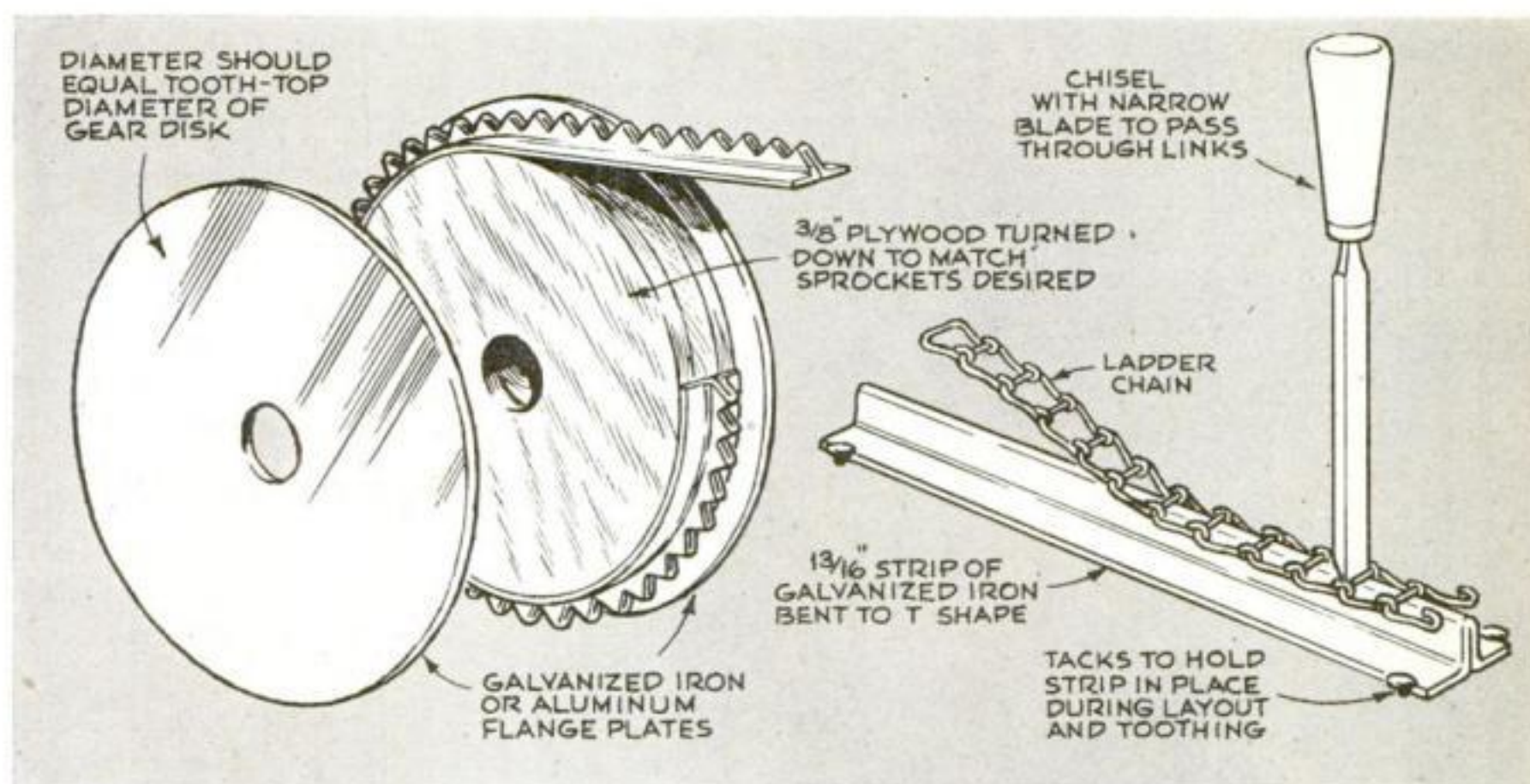
[\[Continued on page 196\]](#)



Homemade cement mixer on tractor

This ingenious portable cement mixer was designed and built by J. V. Rupert, an Ohio fruitgrower. Basically, it's a 55-gallon oil drum mounted on a farm tractor and rotated by the power take-off. The tractor

hydraulic mechanism also is put to use to raise the bottom end of the drum when cement has been mixed and is ready to be poured out. Two idler wheels mounted under the open end let the drum rotate easily when power is applied by means of a belt.—*John Krill, North Lima, Ohio.*



Custom-made gear wheel

Sprocket gears aren't always easy to find in the size that you need and can be fairly expensive. I make my own, tailored to ladder chain.

I even form my own T strip: I scratch a line down the center of a flat metal strip, fold it lengthwise, bend back a flange on each side, and run solder into the slit. You can skip this step if you can find sliding-door track to match the width of the chain you want to use.

Tack down a T strip an inch longer than

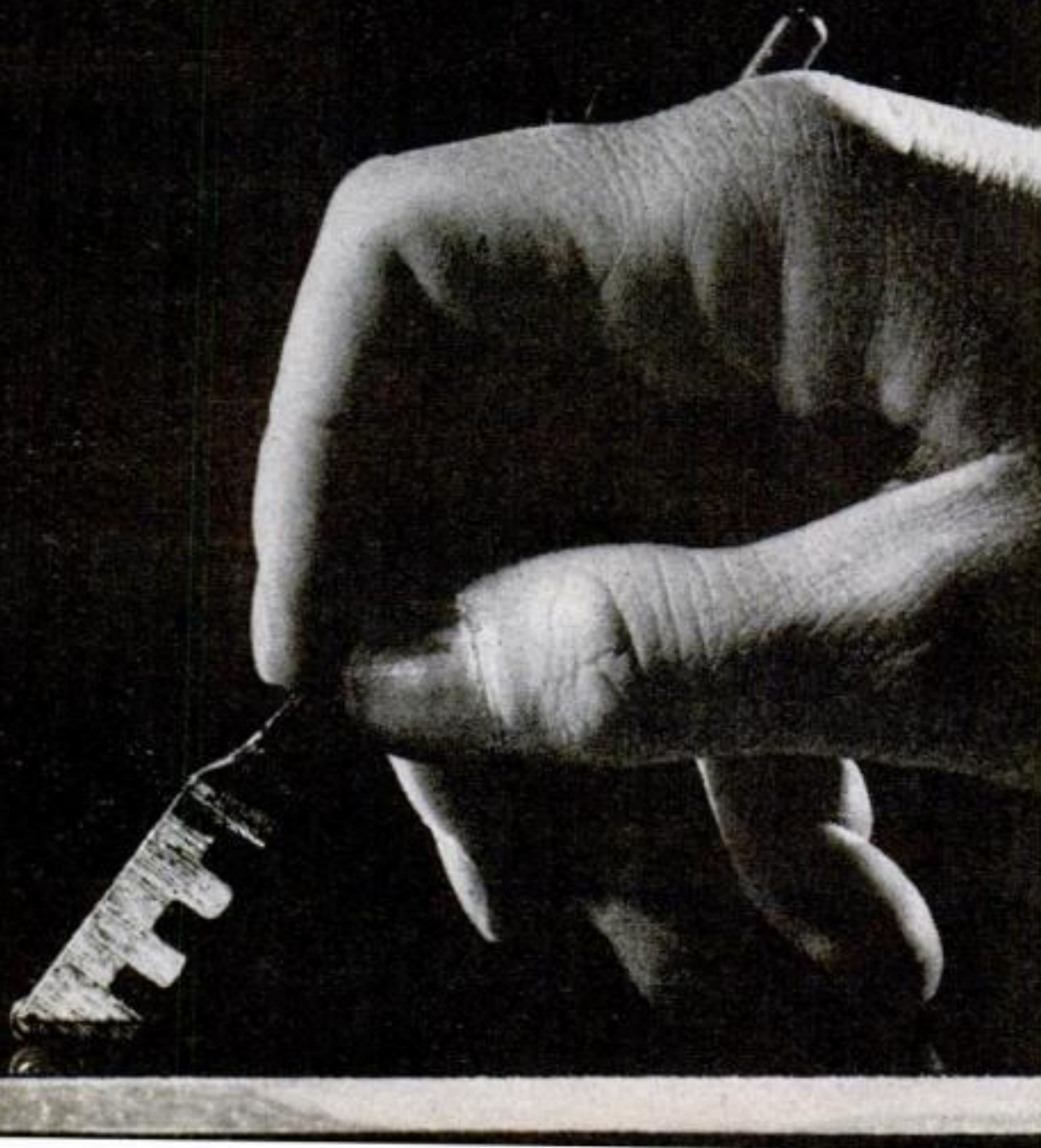
is needed for the number of sprockets desired, and stretch ladder chain on top so the links straddle the ridge. Place a sharp chisel flat against the crossbar of each link, in turn, and tap a nick in the ridge. Use a saw file on these nicks to cut teeth to the required depth. Drill small holes on alternate sides of the toothed ridge, and nail the strip snugly around the edge of a plywood disk.

Unless the gear is to run at slow speed, nail a metal flange plate to each side of the disk to form a track for the chain.—*W. F. Durnal, Michigan City, Ind.*

A Pro's Secrets for Successful Glass Cutting

Don't waste your time reading this if you've never made a bust cutting a piece of glass. But if you're like most home handymen, sometimes your glass-cutting jobs come out fine and other times they're a miserable failure. This is so common that a kind of folklore has grown up that success in cutting glass depends mainly on your frame of mind and luck—that know-how and skill have little to do with it.

Actually, there is a lot of subtle know-how behind the negligent ease with which a pro flicks through one perfect cut after another. Here are the true facts about glass cutting from a professional glass cutter—the inside story known to few people outside the ranks of those whose livelihood depends on making a perfect cut every time.



By Leo. H. Kenney

A PERFECT cut in glass leaves edges that are square to the surface and free from flakes, flares, chips, and shark's teeth. These terms may be unfamiliar to you, but if you've ever tried to cut glass, you have seen them. You'll recognize them in the photos. Study these defects carefully—they are your clues to what you may be doing wrong.

The new epoxy adhesives make possible a whole new category of exciting and interesting projects you can make entirely of glass. You can glue flat sheets of glass together at right angles to construct boxes, tanks, light fixtures, canisters, and the like. But the edges of the glass must be true and smooth. The chip-and-chew methods of glass cutting that were good enough for replacing window panes certainly won't do.

Choose the right tool. The stem (handle) and wheel of your glass cutter are both important. Most experts insist on a straight stem. Fancy shapes or balls on the end of the stem interfere with the proper holding position.

Wheels made by different companies vary in hardness and taper. The taper determines how much the wheel "digs" into the surface of the glass and how much hand pressure is needed to make a proper score. A moderately sharp—or even slightly dull—wheel, used with just enough pressure to give a good even score, will give you the best break. An extremely sharp wheel is trickier to handle and will cause score flakes with the slightest over-pressure. This invariably makes breaking more difficult. A

wheel's hardness determines how long it will last before the edge gets too dull to use.

Proper lubrication of the cutting wheel, often overlooked by a novice, is an absolute must. To make a good score, the wheel must turn freely under pressure as it is moved across the glass. If it sticks on its axle and slides on the glass for even the shortest distance, you are not only likely to get a poor break, but you'll make a dull spot on the wheel. A wheel with a dull spot should be thrown away. Glycerin is, by far, the best lubricant. Dip the wheel in it before drawing each score.

Scoring and breaking. Hold the stem as shown in the photos. Incline the tool slightly in the direction of travel. Be sure the flat side of the tool bears flat against the straightedge. If it is cocked slightly, it will crawl away from the straightedge before the score is completed. Make the score with a smooth, sweeping stroke, maintaining a moderate, uniform pressure on the tool. Don't bear down too hard. This will only make it more difficult to get a clean break. If excessive pressure is needed to mark the glass, it means your wheel is dull and should be discarded.

Never score a piece of glass on a hard surface. Choose a work surface that is flat and smooth. Cover it with a pad made of a number of layers of newspapers. Use single-sheet layers with no folds, or overlaps. For glass over $\frac{1}{8}$ " thick, add a layer of soft cloth on top of the pad.

If you make a bad score, don't try to go back over it or fill in skips. Double-scoring will make the glass harder to break clean, and will ruin the wheel, as well. Your best bet: Turn the glass over and score it on the opposite face, directly over the old score.

Make your break as soon as possible after scoring. An old story to the pros, but one not generally known, is that glass starts to "heal" immediately after scoring. The longer you let it set, the more trouble you'll have getting a good break.

There are two accepted methods of breaking: snapping and finger breaking. Snapping is the most common and easiest to master.

The best way to snap is to place the score about an inch back from the table

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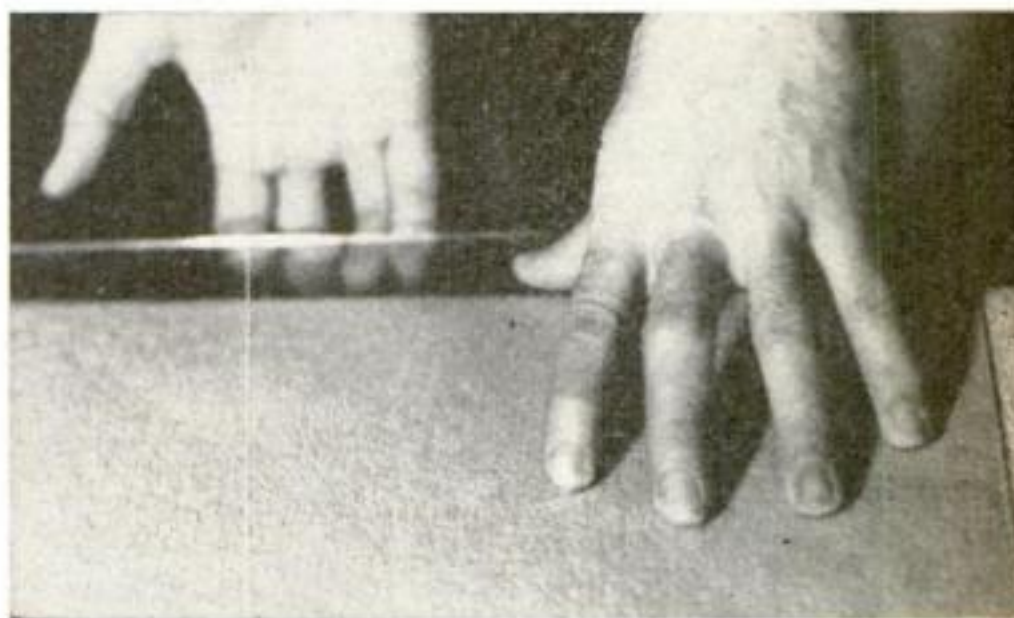
Apply pressure for finger break by placing right thumb on knuckles of left hand and squeezing. Press down with left hand, distributing pressure equally between fingertips and heel.



Grip the cutter as high up on the stem as possible. Hold the lower flattened portion between the thumb and index finger with the upper part passing between index and middle fingers.



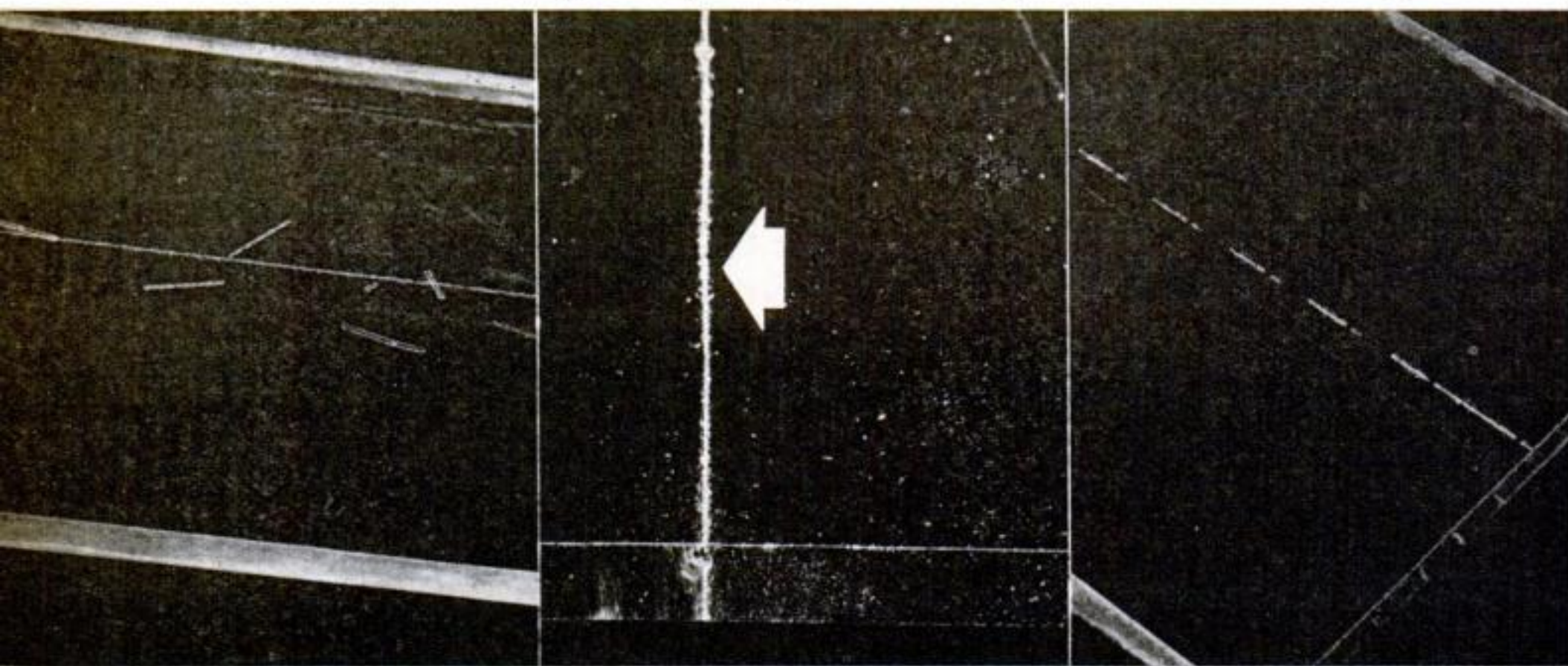
Snap the scored glass by lifting the plate about three inches above the table, holding the smaller half as shown. Flick it down and stop abruptly with a sharp snapping action.



Finger breaking requires the application of a steady pressure, using a finger of the right hand directly under the score. Left hand is moved, as below, to bridge score on top of the plate.



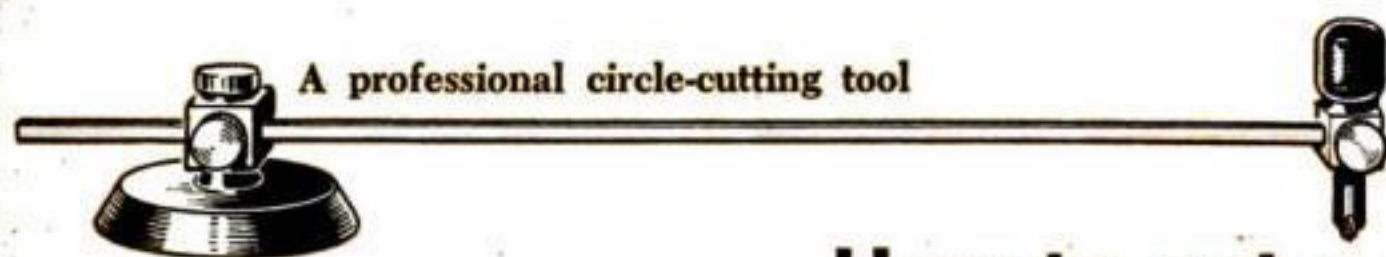
Want to improve your glass-cutting skill? Learn to recognize



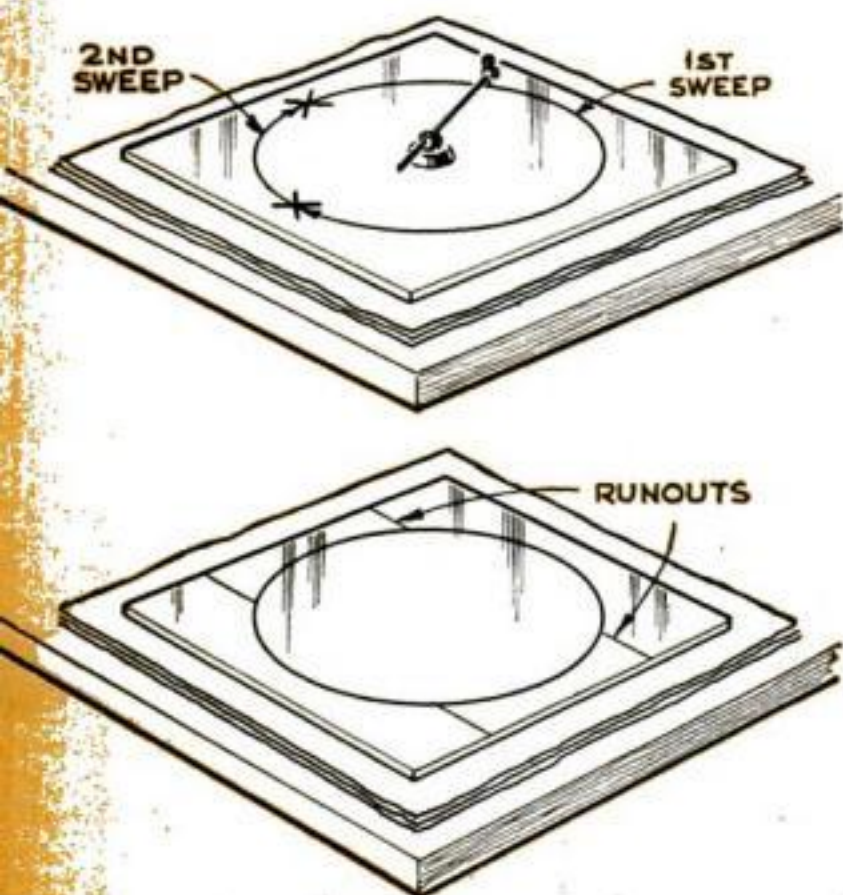
Score flakes usually erupt from the surface of the glass after scoring, the result of using an extremely sharp wheel. Sometimes they seem to explode from the score. The flakes are very fine sticklike glass slivers. When flakes appear, lessening hand pressure on future scores is the only remedy aside from deliberately dulling the wheel slightly on pieces of scrap glass.

A wobbly score can't produce a clean break. In addition to wavy edges, the corners will be rough and ragged. The wrong grip on the cutter is the worst offender. If you hold it too far down on the stem, clinch it too tightly, or move it with a hesitant, uncertain stroke, it's practically impossible to make a clean, uniform score. Practice a confident stroke.

Skip in the cut usually is the result of a defective cutting tool. A dull spot on the wheel causes the dash-space-dash score. When skip appears, the wheel should be discarded. Dull places on the wheel develop from overscoring, failure to lubricate the wheel, or careless storage and handling. Cutting old glass without cleaning it will dull the wheel, too.



How to cut a perfect circle

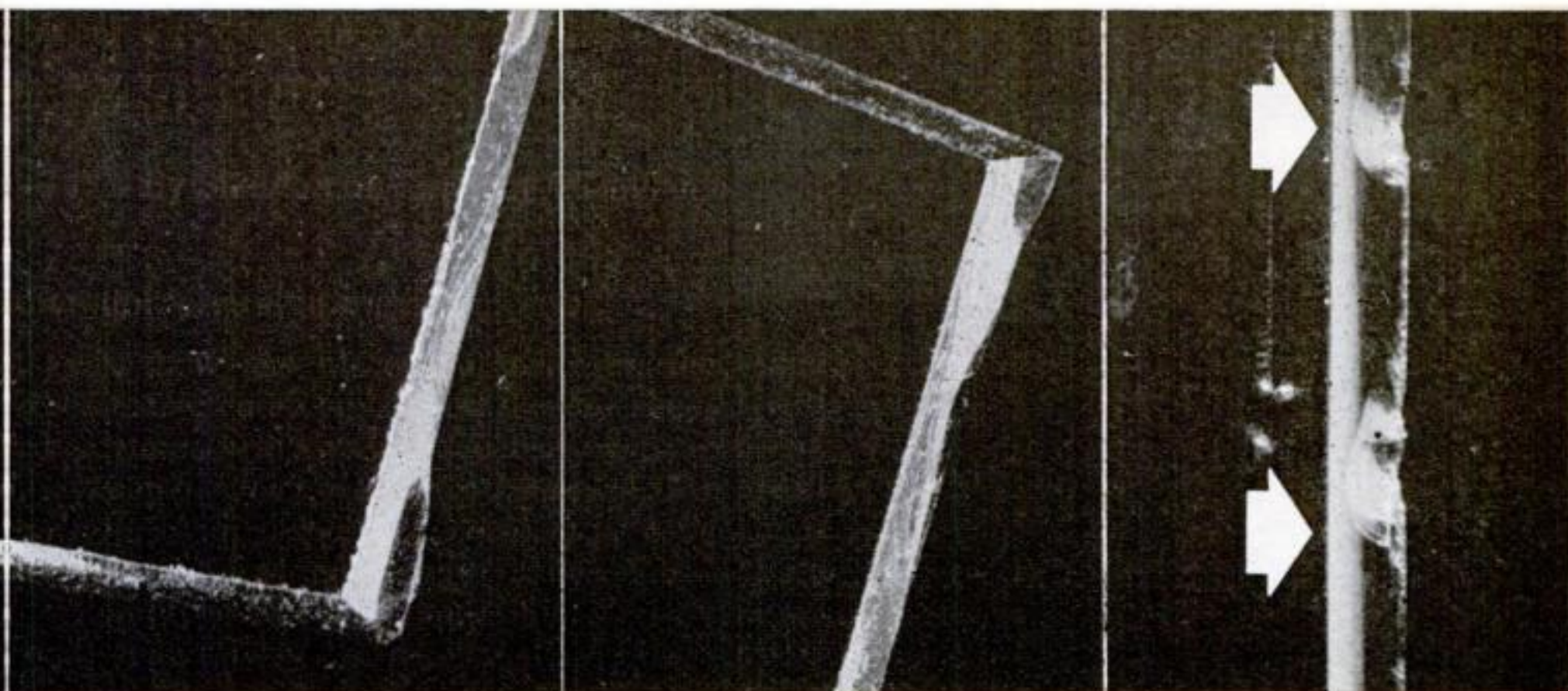


Draw the score for a circle in two sweeps. Work at the table corner so you can move around to get in position for the second sweep without moving the glass. Start the second part of the score precisely at the end of the first part and end it precisely at the beginning of the first part to avoid overscoring or leaving a skip.

The trick for getting a smooth edge is to press out the circle rather than tap it out as most people do. Tapping will give a chewed edge. Turn the glass over so the scored side is lying on the pad of newspapers. Place your thumbs an inch or so apart directly over the score. Increase pressure on them until you see the fracture shoot through the glass. Repeat the process, moving your thumbs a little at a time until you have gone completely around.

When you are sure the fracture extends through the glass for the complete circle, turn the sheet over again with scored side up. Score four runouts as shown. Tap these through with the blunt end of the cutter—*don't try to press the runouts*. When the runouts on both edges of a piece of waste have been tapped through, you'll find that you can simply lift the waste away from the circle.

these common defects and know what causes each of them



Finger flares show up as an unevenness in a finger break where the break is started. They are caused by incorrect positioning of the finger under the score or by the improper distribution of pressure between the fingertips and heel of the left hand. Finger flares are more likely to occur when the score is not near the center of the sheet of glass.

Opposite flares look almost exactly like finger flares, but they appear at the opposite side of the plate where the score was started. They are caused by scoring too lightly (not enough hand pressure), beginning the score too far away from the edge of the glass, or working on an uneven table surface with not enough padding under the sheet of glass.

Chips are common because anything causing the wheel to deviate from straight-line, rolling contact with the glass invites them. Allowing the stem to wobble from side to side, or an uneven straightedge, will put side pressure on the wheel, making the cutting edge dig chips out of the side of the score. Cutting dirty glass may also cause chips.

edge and parallel to it. Grasp the overhanging glass firmly between the thumb and fingers of both hands with fingers underneath. Lift the entire sheet two or three inches above the table and flick it downward, stopping the movement abruptly with a sharp snapping action. The piece remaining in your hands should be parallel to the plane of the table when the glass snaps.

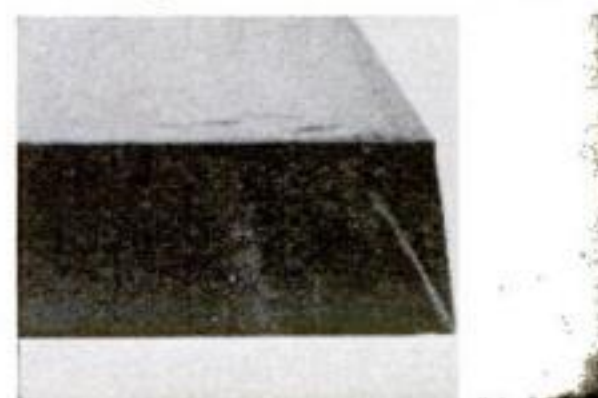
Finger breaking is a little more difficult, but it increases your chances of producing smooth, square edges without flaws. Place the glass with the edge overhanging the table edge by a couple of inches and with the score perpendicular to the edge. Put the index finger of your right hand under the score at the edge of the glass. Cup your left hand and place it on top of the glass so that the score passes under your hand halfway between the points where the heel and fingertips rest. Put the thumb of your right hand on the knuckles of your left hand. Lift the glass slightly with your index finger and apply downward pressure with your left hand. Distribute the pressure evenly between the heel and fingertips. The break will start directly over the index finger, and as you increase the pressure by squeezing with the right hand, the break will shoot to the opposite edge of the glass. Don't try to finger-break a skipped or imperfect score.

It's wise for the beginner to use a leather stall, or at least a few layers of tough plastic tape, over the index finger to avoid cuts when using the finger-breaking technique. ■ ■



Shark's teeth, more apparent on thick glass, are an indication that the cutting wheel is getting dull. Once shark's teeth appear, all future cuts with the wheel will have the defect.

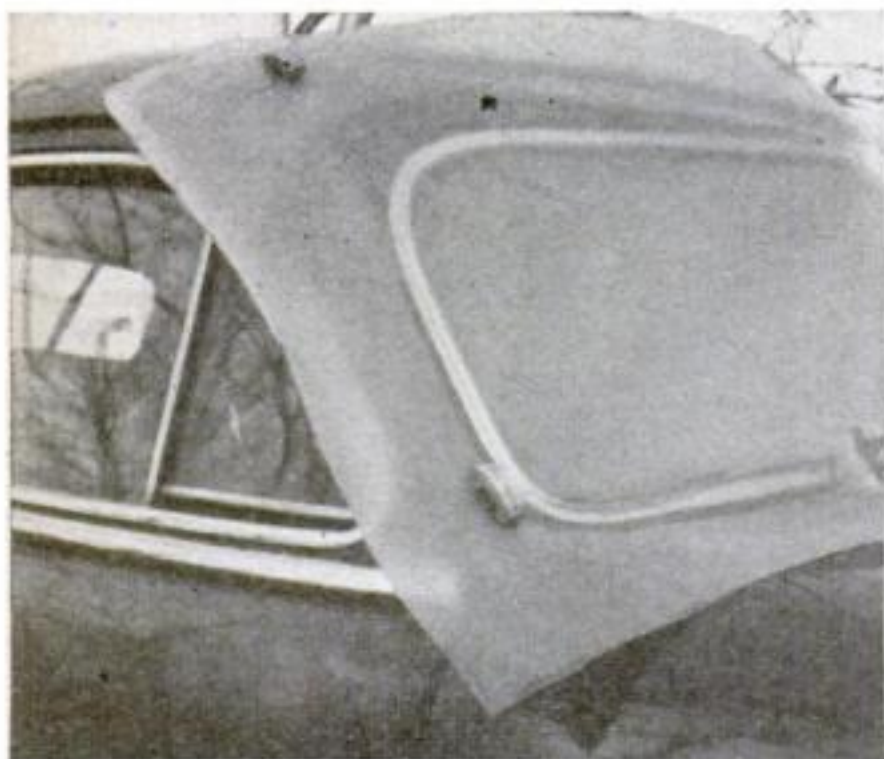
Length flare is failure of the glass to break square to the surface of the plate. It happens mainly when snap-breaking, result of improper snapping or allowing the score to heal.





Fuel pump for model airplanes

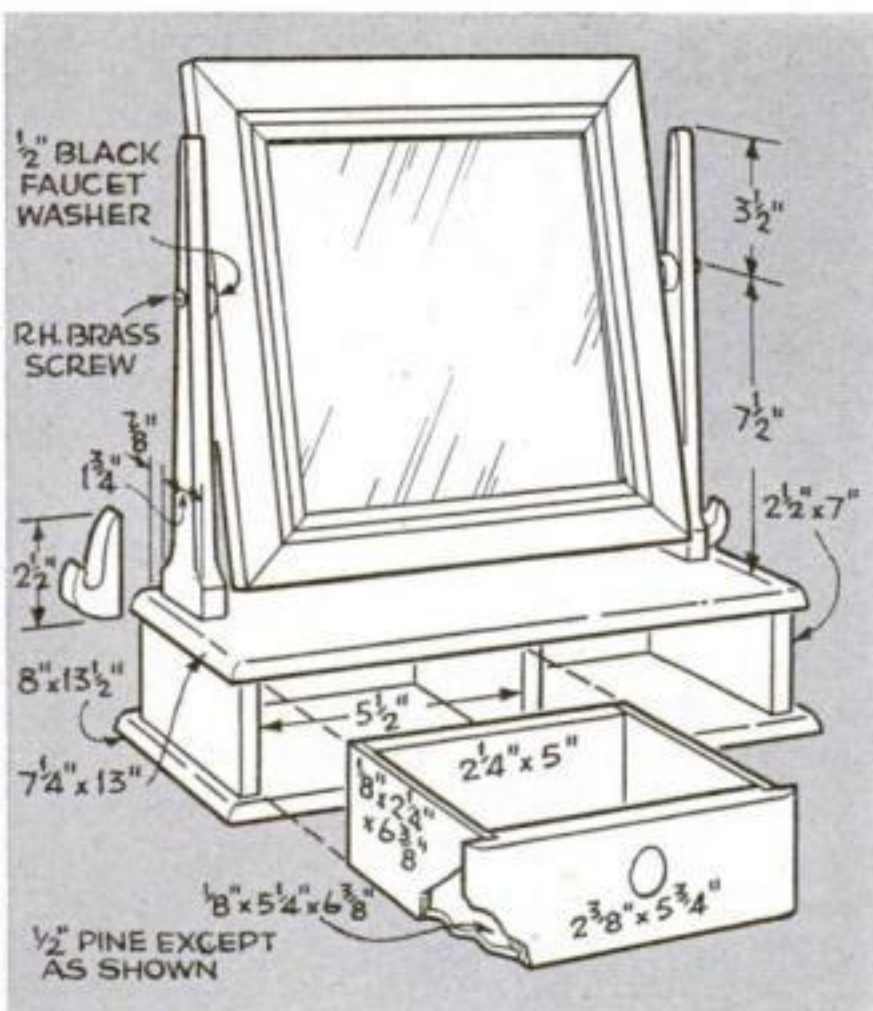
You can make a handy pump for filling model-plane tanks. Remove the ball from a ball-point cartridge by touching it lightly to a grindstone. Twist the tip from the tube and cement it to a hand-lotion dispenser.—*Robert Micals, Freehold, N. J.*



Magnets hold windshield cover

Each time I parked my car outside last winter I stretched a plastic floor protector across the windshield, anchoring the corners with magnets. When ready to drive, I pulled the cover off and stored it in the trunk. Not once did I have to scrape off ice or wipe away condensation.—*Bob Blatt, Larchmont, N. Y.*

▶▶▶ Pad the front edge of a drafting board with a strip of foam-rubber window striping. When you lean against it, it will be easier on you and on your clothing. You can tack the strip in place.



Old-time mirror stand

A man's dresser is rarely graced with a mirror. To avoid trips to the bathroom to knot your tie, make this old-style mirror stand. It has two drawers to keep cufflinks and other small items from straying. Before you start construction, buy a mirror in an unfinished frame—or make your own with mitered molding. Don't fasten the top on the drawer section until you've mounted the mirror supports. The screws that hold these must be driven up from below. The stand shown was finished with a mixture of burnt umber and linseed oil, rubbed in with a cloth.—*W. P. Taylor, Independence, Mo.*

SHOP TALK

By Sheldon M. Gallagher



A new concept in machining—abrasive shaping

Bet you can't guess how the pieces at left were machined. Actually, they weren't machined at all. They were shaped with grinding wheels in a process recently pioneered by Norton Co., well-known maker of abrasives. Unlike surface grinders, the wheels are used to remove large amounts of metal, forming actual shapes. Advantage: In a single setup, a rough metal blank can be sized, shaped, smoothed, even polished, without moving the work or changing the tool. Note in the two lower samples at left how even delicate flutes for a tap can be ground from a blank cylinder. In many cases, the abrasive wheels are found to hold closer tolerances than conventional cutting bits and to waste less metal since they don't have to cut deeply to get under tough scale. The result, says Norton, is that the new method can save up to half the time and two-thirds the cost of conventional machining. While the technique was developed for industrial use, it can be applied in many ways in small job shops, even home machine shops. For more details, write Norton Co., Worcester, Mass.



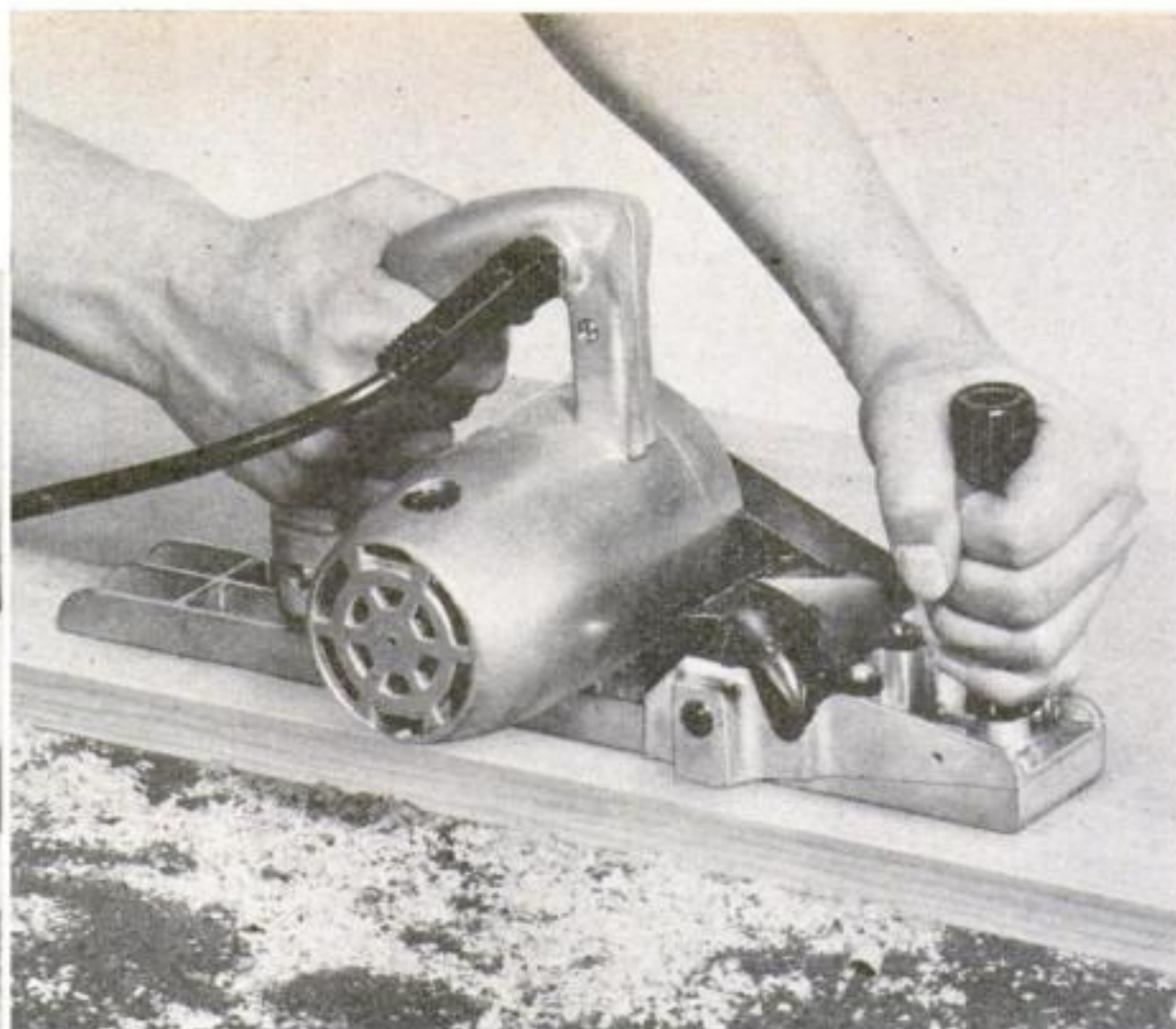
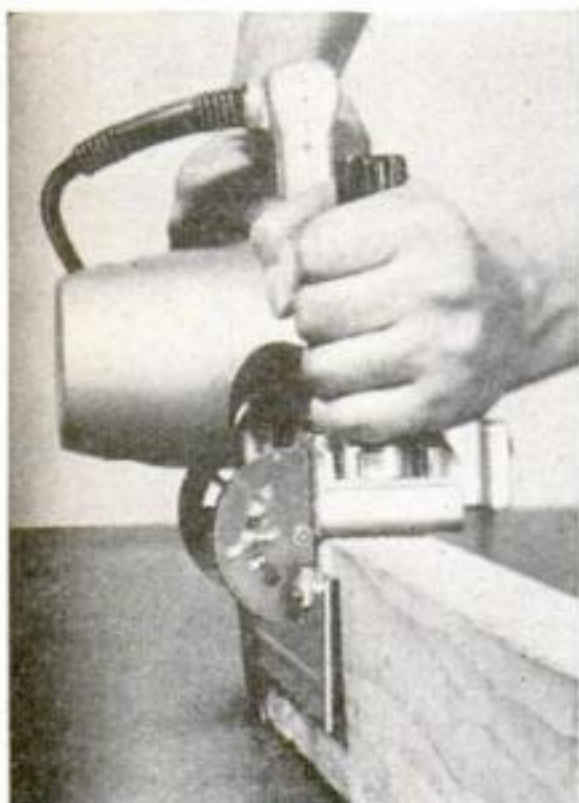
More about that mystery tool

We may have a solution to that strange-looking tool we asked readers to help identify last August. Replies have been pouring in, and by far the biggest number insist it's a tool for fashioning Granddad's corncob pipes. The reamers form the bowl, the slot gauges wall thickness, and the cutter trims off the stem as it's chewed. Our thanks for the fine detective work.

Two helpful aids for the handyman

Are you forever losing odd-size nuts off bicycles, appliances, and other household articles? To the rescue comes a new type of plastic locknut that's threaded only about three-quarters of the way through. As the nut is turned on a bolt, the metal threads are forced into the unthreaded plastic, locking the nut on tight. The nuts come in a handy package of seven assorted sizes to handle bolts from 3/32" up to 5/16". They sell for \$1 from Standard Portable Products, Box 148, Mayville, N. Y. . . . The Simpson Timber Co. has fancied up two new perforated hardboards for a dressier look in the home. One has a tiny star pattern in addition to standard holes for fixtures. The other has holes only above chair-rail height, providing an attractive wainscot.





Motorized hand plane is both edger and surfacer

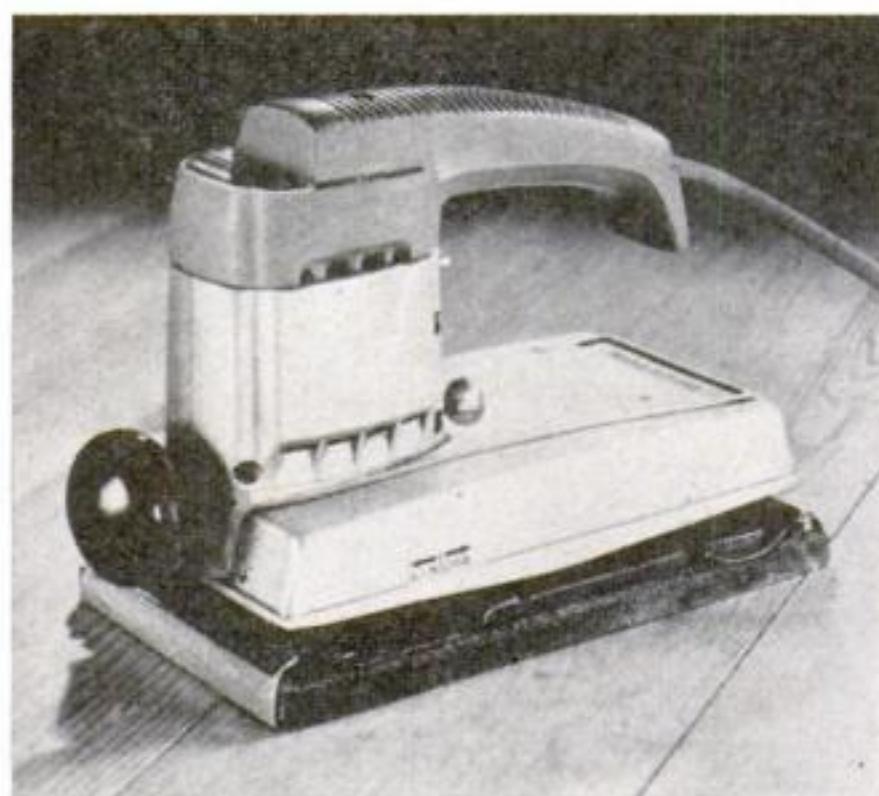
A rotary cutter spinning at 14,500 r.p.m. does the hard work for you in this low-cost electric hand plane. A removable guide allows the tool to edge-plane (left) or surface-plane (right). The front shoe is adjust-

able like a jointer table to vary depth of cut and to keep the tool riding level. A ½-hp. motor permits cuts up to 1/16" deep in a single pass. \$44.95. Wen Products, 5810 Northwest Highway, Chicago.



A metal nibbler for the home shop

This new metal-cutting power nibbler slices through sheet steel at the rate of 40" a minute. The tool, designed to cost less than conventional nibblers, is aimed at home-shop craftsmen as well as professionals. It has a three-amp motor, a replaceable carbide punch, and will handle all metals up to 18-gauge steel. \$64.95. Skil Corp., 5033 Elston Ave., Chicago.



Sander lets you choose its action

Flip a switch and you can select either orbital or straight-line action on this dual sander. Set on orbital, the tool gives you 4,900 oscillations a minute for fast stock removal. For fine smoothing, you get 5,000 straight strokes a minute. The tool has a shockproof handle and a front knob for two-hand control. \$39.95. Disston Div., H. K. Porter Co., Porter Bldg., Pittsburgh.

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what's new

...ELECTRONICS

5-Inch Transistor TV Performs Anywhere

PRACTICAL portable TV has finally arrived. With this tiny set you can watch TV just about anywhere within range of a TV station—on a park bench, in a canoe, or riding a horse. It also can be plugged into a wall outlet in the living room.

I carried one around with me for several weeks, trying it under a wide variety of conditions. Most remarkable, to me, was the brilliance and clarity of the picture. The definition, sharpness, and tonal range are better than you'll see in most conventional full-size sets. It's bright enough to watch almost anywhere but in bright sunshine.

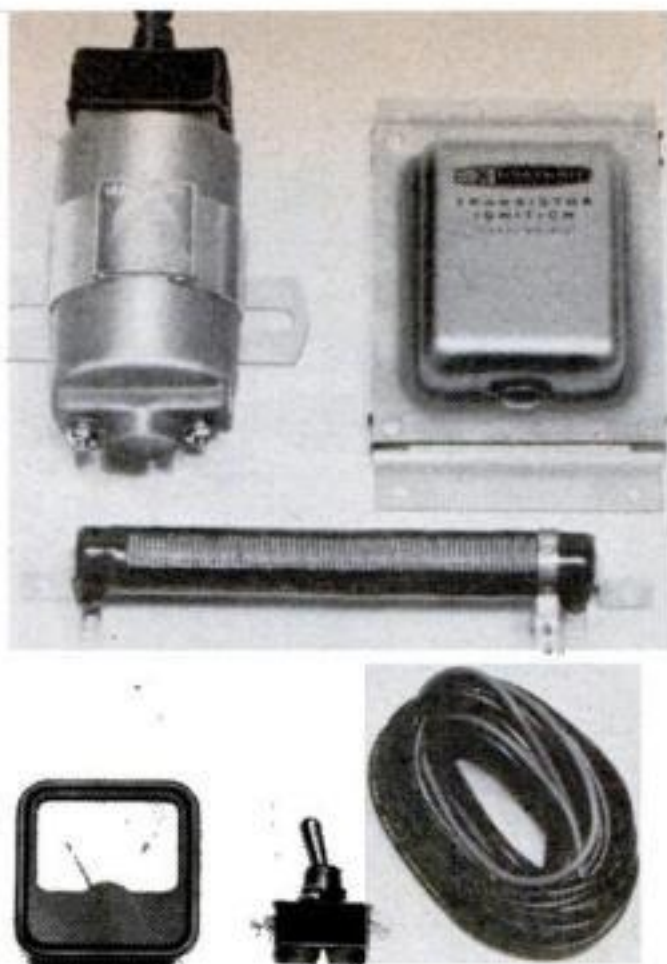
I got excellent reception 25 miles from the transmitter, using only the whip antenna on the set.

It has all the usual controls conveniently located at the front. There are jacks for two earphones. One earphone comes with the set. Plugging into one jack cuts out the loudspeaker; the other allows both speaker and earphone to play.

The set, imported by Sony, 514 Broadway, NYC, costs \$242.90 with case. The battery pack is \$39.95.—*Hubert Luckett.*

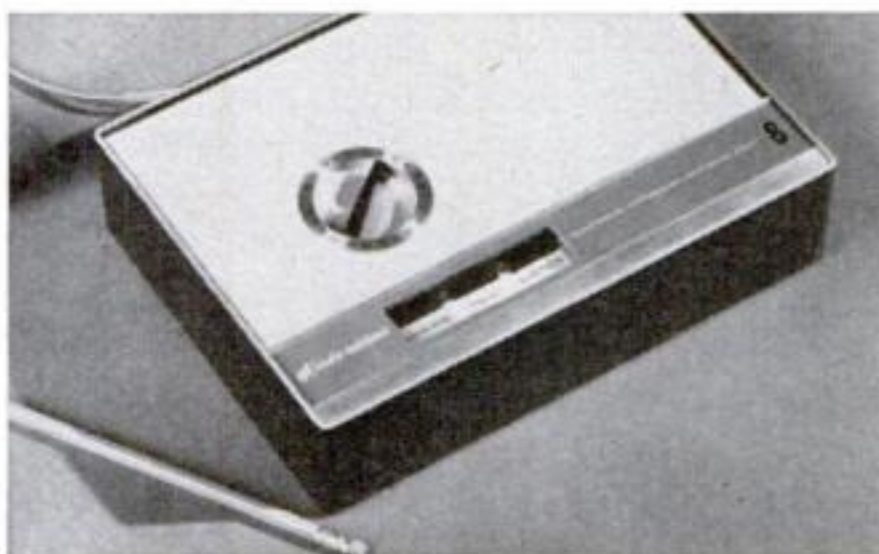
Recharging is easy. Plug the charger into an ordinary outlet. The 15-volt alkaline battery should be recharged after four hours of use. It's said to take more than 40 charges.





Transistor ignition kit for your car

Transistorizing your car's ignition is easy with this new kit. A meter and adjustable ballast resistor allow adjustment of current draw to the optimum setting for any car. Complete kit sells by mail order for \$34.95. Heath Co., Benton Harbor, Mich.



New unit for language labs

A battery-powered receiver lets language students hear taped programs or the teacher's voice without plugging in cords. Students may also record their own speech and compare pronunciation with that on tape. Electronic Futures, New Haven, Conn.

New package for RTV silicone rubber

RTV (room temperature vulcanizing) liquid silicone rubber, one of the popular new miracle materials, is now sold in a mixing-dispensing package. The liquid silicone cures to a resilient rubber after addition of a catalyst. The curing agent is squeezed from an attached tube into a plastic envelope containing the rubber. The two are mixed by kneading, then dispensed through a plastic spout.



Hi-fi kits come in a toolbox

Designed for the novice builder, this new line of hi-fi kits is packaged to make construction easy even if you have to work on the kitchen table. Parts are safely stored simply by closing the wings any time work must be interrupted. The kit manual gives theory along with the step-by-step instructions. A continuity probe in every kit permits checking each stage as you finish it. Harmon-Kardon, Westbury, New York.



Wrist radio uses seven transistors

Claimed to be the world's smallest seven-transistor, superhet radio, this tiny unit is said to perform as well as the larger pocket-size radios. It is powered by two small mercury cells. Imported from Japan, the Micronic Ruby sells here for about \$22.



Kit-Built Electronic Organ Uses Transistors

THE kit version of the Thomas two-manual transistor organ is said to give you the same music as the factory-assembled instrument. Heath engineers have adapted the design to make home construction as easy as that expected of ordinary hi-fi kits. The transistorized tone generators are on easily assembled circuit boards. Instructions are included for quick, easy, and accurate tuning without the use of special instruments.

The specifications read like those of a true professional instrument:

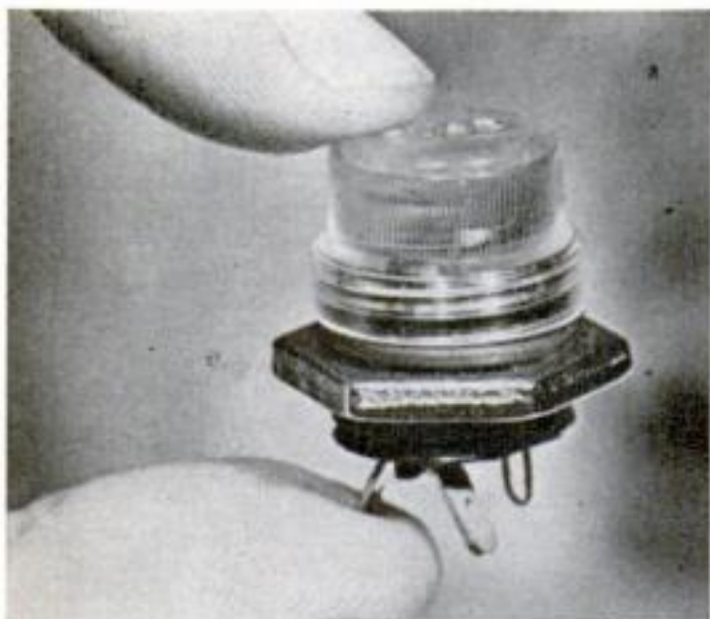
- 10 organ voices—trombone, reed, flute, oboe, cornet, violin, saxophone, horn, viola, diapason.
- Variable bass-pedal volume control.
- Manual balance control to adjust the relative volume of the two keyboards.
- Variable vibrato.
- Standard expression pedal.
- 13-note heel-and-toe bass pedals.



- Overhanging keyboards.
- Finished, hand-rubbed walnut cabinet.
- 20-watt peak-power amplifier.

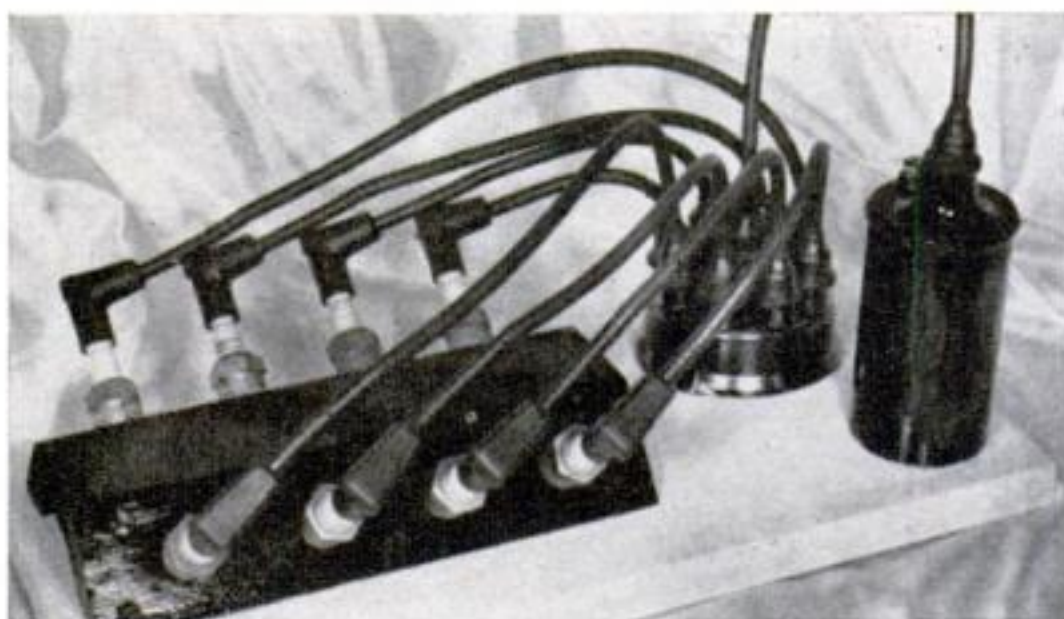
The kit sells for \$329.95; matching bench, \$24.95; recorded lessons, \$19.95. The Heath Co., Benton Harbor, Mich.

▶▶▶ Stereo sound for television may not be far off if the FCC goes along with a recent request made by General Electric. GE has proposed a system for TV stereo sound that they say will be inexpensive for receivers and not too costly for TV stations.



New device protects transistors

Wired into a circuit, the Transistor Protector guards against costly damage resulting from misapplied voltage or current surges. Littelfuse, Inc., Des Plaines, Ill.



Now glass conducts electricity

A new controlled-conductance fiber-glass roving is being used for the first time in auto-ignition cable, and is now specified for Fords and Ramblers. It is said to take abuse better than the organic materials generally used for resistance-type ignition wires.



You Can Put Up This Wall Without Furring Strips

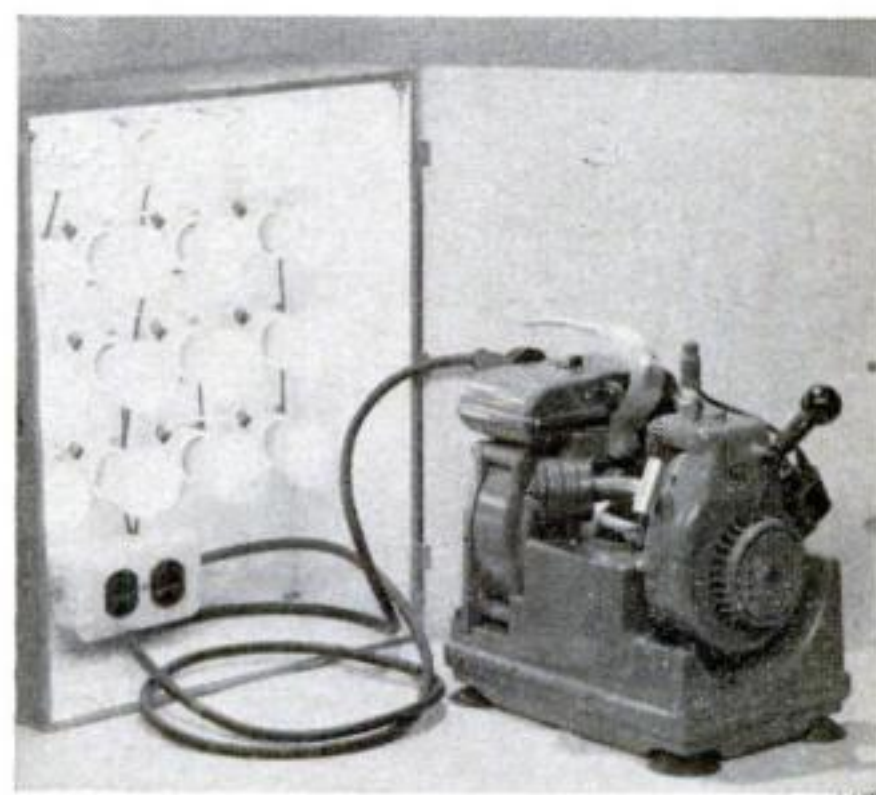
Veneer-faced paneling V-grooved in random-board widths is now made 7/16" thick. Unlike ordinary 1/4" plywood, it can be nailed or cemented directly to studs with no solid backing or back-up furring strips.

Grooves are arranged so that one is always over a stud to conceal nails. Prefinished faces include cherry, oak, birch, maple, mahogany, walnut, and elm. Craftwall is made by Weyerhaeuser Co., Tacoma, Wash.



Foam-plastic insulating tile

A new material for ceilings—plastic foam—is molded into textured 24"-square tiles with shiplap edges. You can snap them into a T-bar grid system for a dropped ceiling (as shown above) or fasten them directly to an existing ceiling with nails or adhesive. The normal 1" thickness has good insulating qualities, but you can order tiles up to 8" thick for special requirements. Called Nu-Way ceiling tile, the material is made from Dylite foam by the United Progress Co., Albany, N.Y.



Tiny power plant puts out 300 watts

This portable light plant weighs only 14 pounds but is capable of sustained production of 250 to 300 watts at 110 volts AC. It contains a brushless alternator-type generator turned by a 3/4-hp., two-cycle Ohlsson & Rice engine at 6,300 r.p.m. You start it on a built-in battery, then switch to magneto once it's running. It will light several lamps or power an appliance within the rated capacity. Dyno-Mite is made by Nichols Industries, Jacksonville, Tex., and will sell for less than \$100.

what's new

.....BOATING

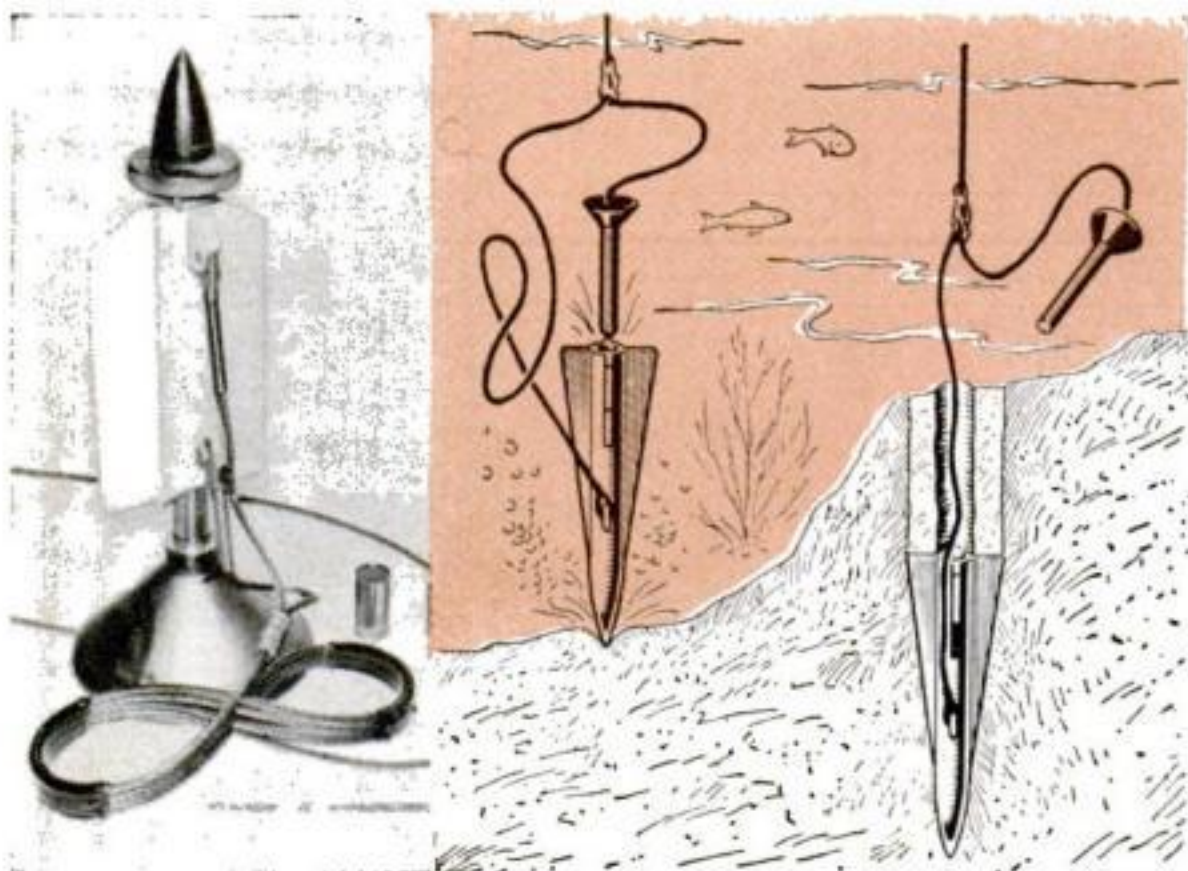
Packaged galley for snacks aboard 17-footer

This galley fits handily in a 17' 5" boat. The unit includes a two-burner alcohol stove, stainless-steel sink, three-gallon water tank. There's a storage cabinet below to hold kitchen items. Mounted in the cockpit, the galley gives a medium-size boat big-boat convenience. For Glasspar boats. Glasspar Co., Santa Ana, Calif.



Rollers adjust to hull form

New automatic-adjusting rollers (left) conform to lapstrake hulls, give firm support. Concentric grooves permit roller surface to bend, change shape to give support along entire 9" length. Featured on Dana Hull-Gard trailers. Parish Pressed Steel Div., Dana Corp., Reading, Pa.



An anchor that shoots into the sea bottom

The Seastaple is an explosive imbedment anchor. Just lower it over the side. When it hits bottom a cartridge fires, driving the anchor into the sea floor. When load is applied to the cable, the anchor assumes a horizontal position. Depending on anchor size, it will bury itself from 6 to 34 feet. Price varies according to size. Pneumodynamics Corp., Cleveland.



Now: a Chris-Craft sailer

Here's the first sailboat ever made by the world's largest motorboat builder. The sloop is 35 feet long, has accommodations for six in two cabins, a 60-hp. auxiliary engine. Chris-Craft, Pompano Beach, Fla.



Boat from three auto tubes

Three regular auto inner tubes form the hull of this Converta-Boat. They're attached by steel tubing to a marine-plywood deck. A backrest on the seat supplies comfort. A mount takes up to a two-hp. motor. Easily transported on top of a car, the entire craft weighs 26 pounds, draws four inches of water. \$49.95. Kon-Ko, Inc., Haleyville, Ala.



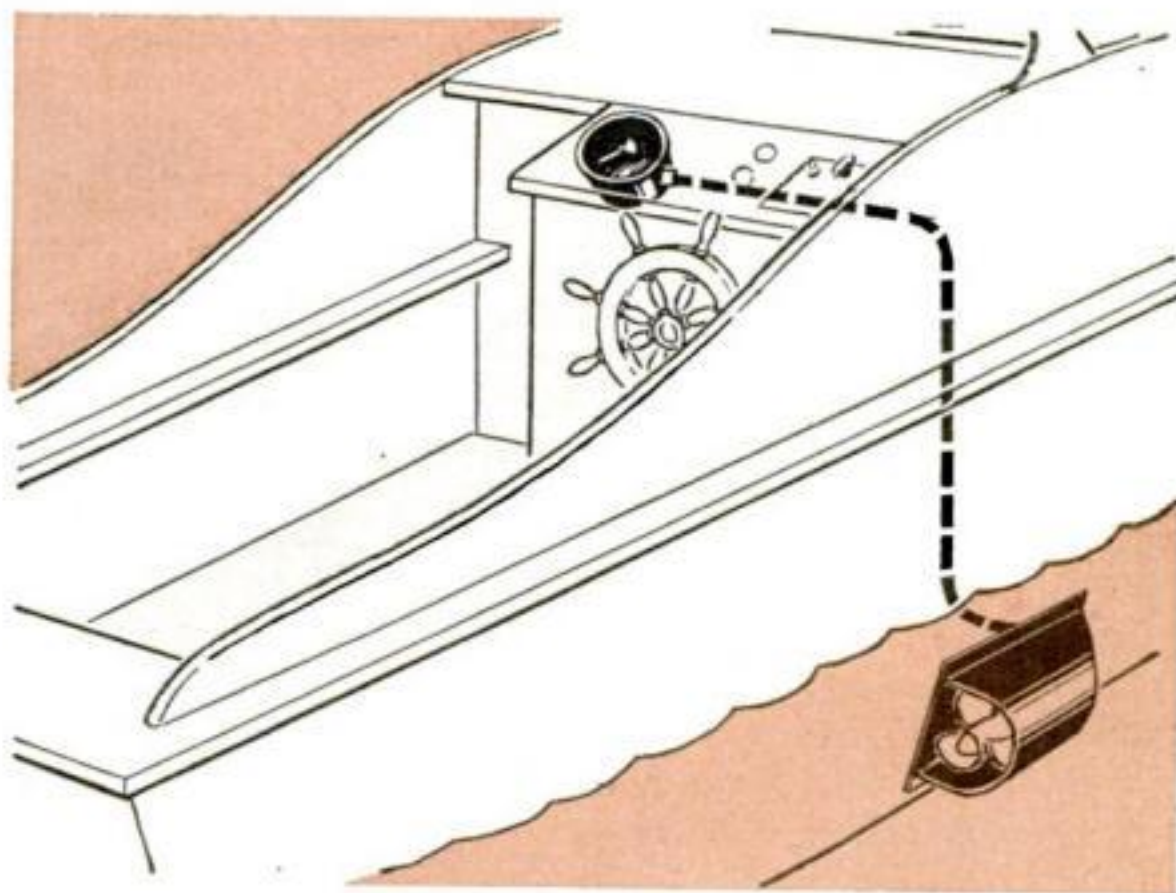
They'll hear this, all right

Hail-O-Matic portable electronic megaphone can be heard for over two miles. It listens, too—will pick up and amplify voices, foghorns, bell buoys. Unit is completely transistorized, operates on batteries or boat's 12-volt system. Can also be permanently mounted. \$149. Instr-O-Matics, 3181 N. Elston Ave., Chicago.



Twin fire extinguisher

New fire extinguisher is designed to be carried from boat to car to home. Bracket also holds spare charge of dry chemical. Port-A-Pac: in cylinder or spherical models, \$20.95. Ansul Chemical Co., Marinette, Wis.



Keeping tabs on speed and distance

Nav-I-Log not only indicates speed, but keeps track of how far you have traveled. An underwater unit mounts through the hull, with a recording head in the cockpit. It comes in three speed ranges, up to 45 knots. In operation, the underwater rotor sends electrical impulses to the recording head. \$177.50. Hurricane Marine Products, Fort Lauderdale, Fla.

How to change a faucet washer when there isn't one

Those modern faucets may seem confusing, but they're really easy to maintain

By Jackson Hand

SLICKING up the old water faucet to meet the demands of modern design, manufacturers have camouflaged many parts so you can hardly find them.

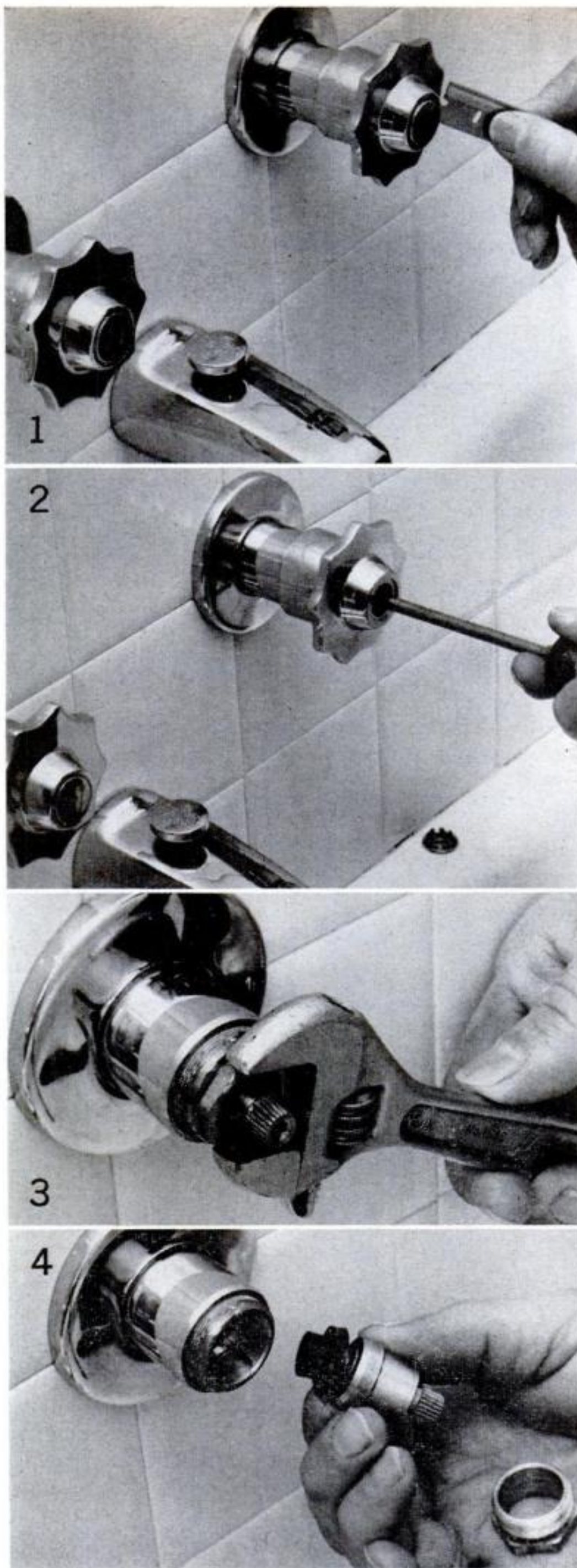
Understandably, this discourages many householders from attempting what used to be a routine chore. Actually it should not.

Modern faucets cost more than old-style models, but they incorporate features that improve performance tremendously. Drips and sniffles happen only once in a blue moon.

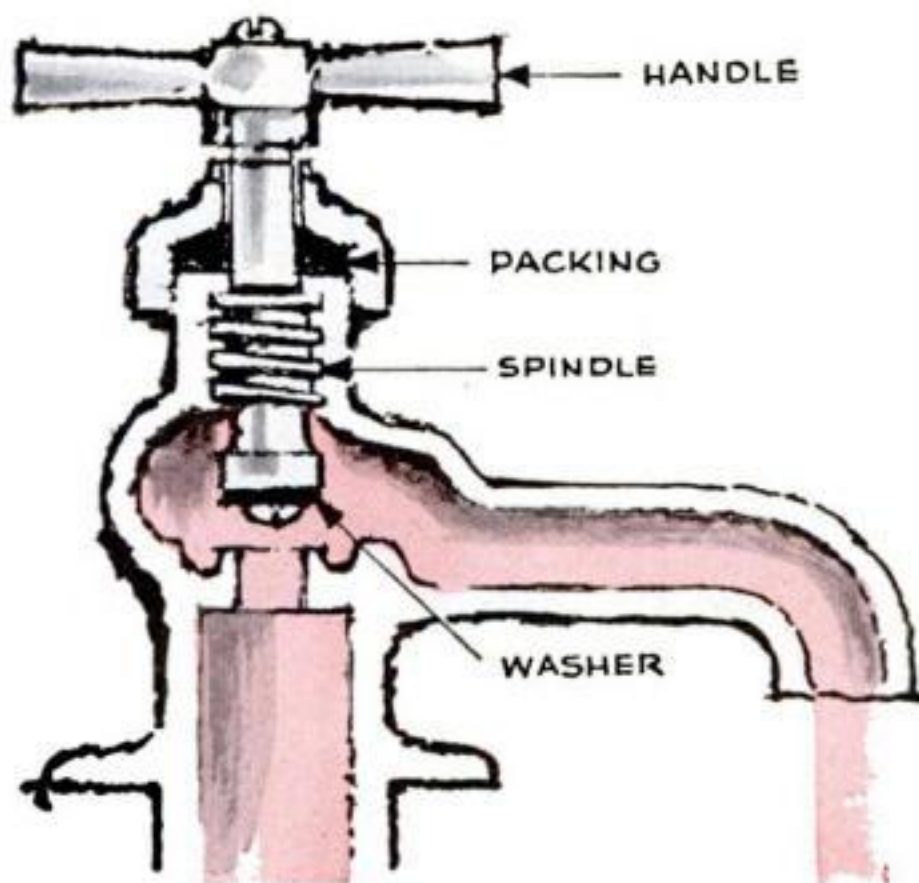
For those blue-moon occasions with modern-design faucets:

- Handles are often canopies to

In new types of faucets, the handle screw may be hidden behind a disk insert (1) that you pry or screw out. You then can remove handle with a screwdriver (2) to get at the retaining nut (3) which holds in the working assembly (4).



How the familiar old faucets and the newer types compare

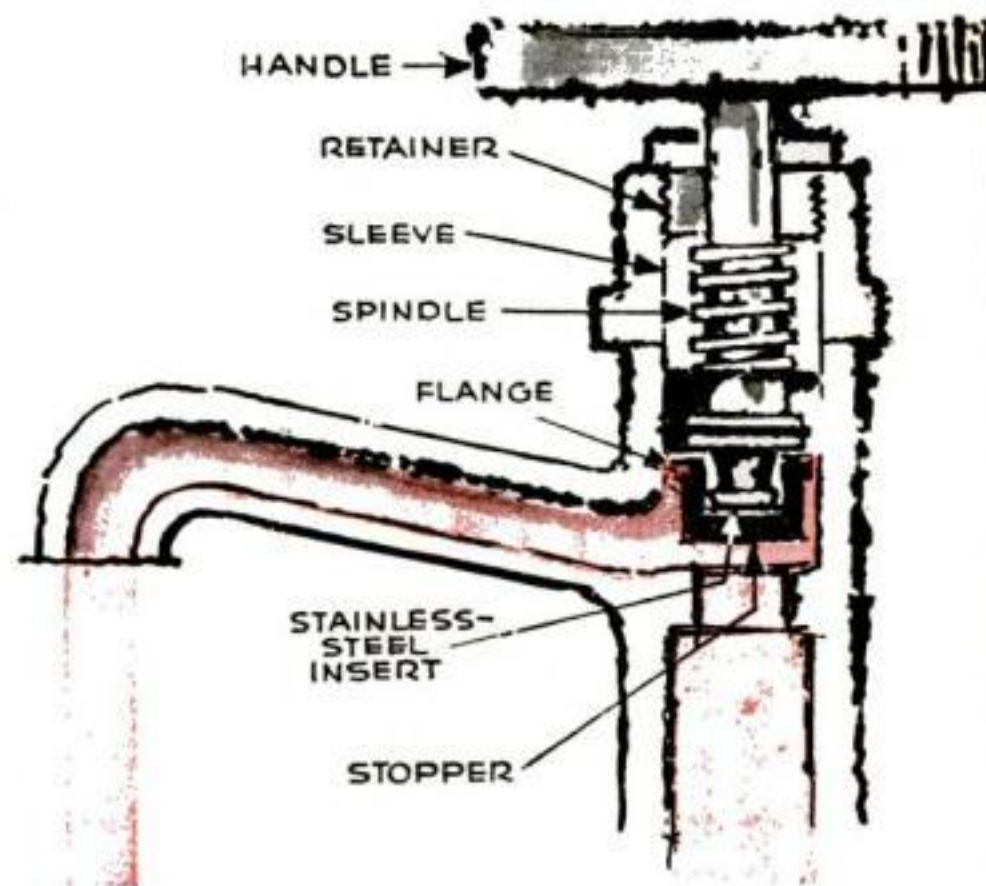


To refresh your memory, the standard water faucet works as illustrated above and below. As shown below, the entire assembly comes out when you remove the packing nut, and you can easily get at the screw (at the base of the stem) that holds on the replaceable washer. Water flows when you turn the handle, causing the spindle to lift the washer from the valve seat.

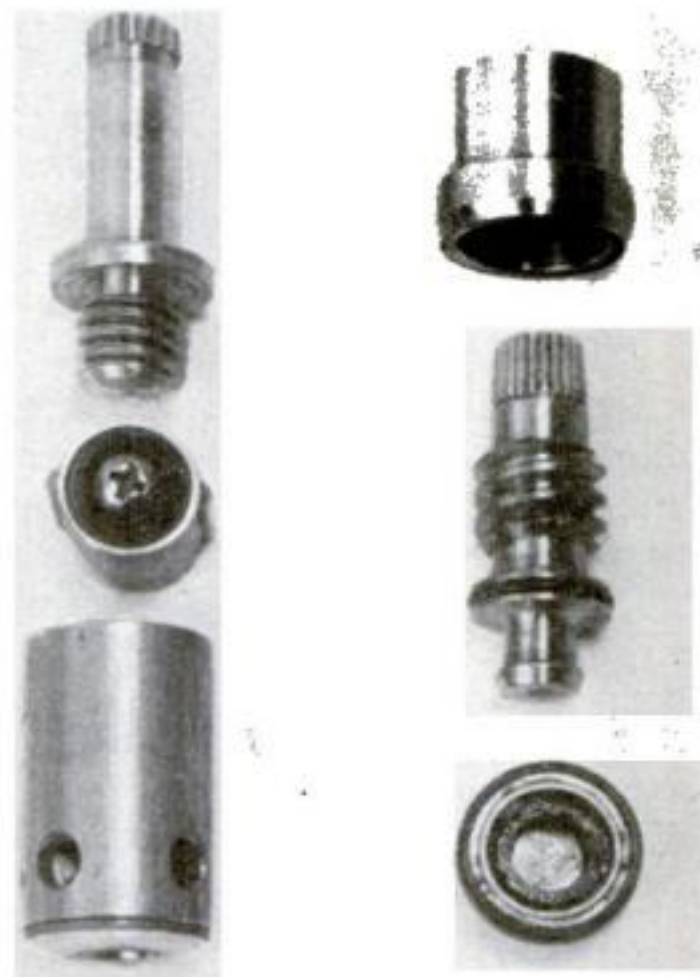


hide working parts. For that reason, it may be necessary to remove the handle before you can get at the insides.

- There may not even be a packing nut. The packing, in old-style faucets, keeps the water from seeping up around the stem. This job is now done by rubber or neoprene gaskets, or by positive brass-to-brass contact that seals off the water below the stem.



One typical modern faucet has the parts shown above and below. Turning the handle causes the spindle to rise in the female-thread sleeve. This removes pressure from the stopper, which then opens, allowing the water to flow. A stainless-steel insert in the washer absorbs wear. The entire assembly comes out of the casting when the retainer is removed with a wrench.



There is a nut—but it simply locks the assembly together.

- There may be nothing that resembles the familiar washer screwed to a spindle. The function of the washer is taken over, however, by some sort of pliable material that plugs the hole.

- All working parts of a modern faucet are usually removable. This means that

everything subject to wear can be replaced as easily as you normally replace a washer. Moreover, since the working parts are usually high and dry, you can lubricate them. The internal parts last longer. If replaced, you have a brand-new faucet.

A screwdriver removes the screw (often a Phillips head) holding the handle. This reveals the stem nut, which comes off with a wide wrench. Now the assembly comes out. In some cases, the pliable stopper material may remain inside the casting. Fish it out with a screwdriver or piece of wire.

Some faucets are of such smooth design you cannot find the screw holding the handle. If you can't see the screw, you can be sure it's below the knob insert.

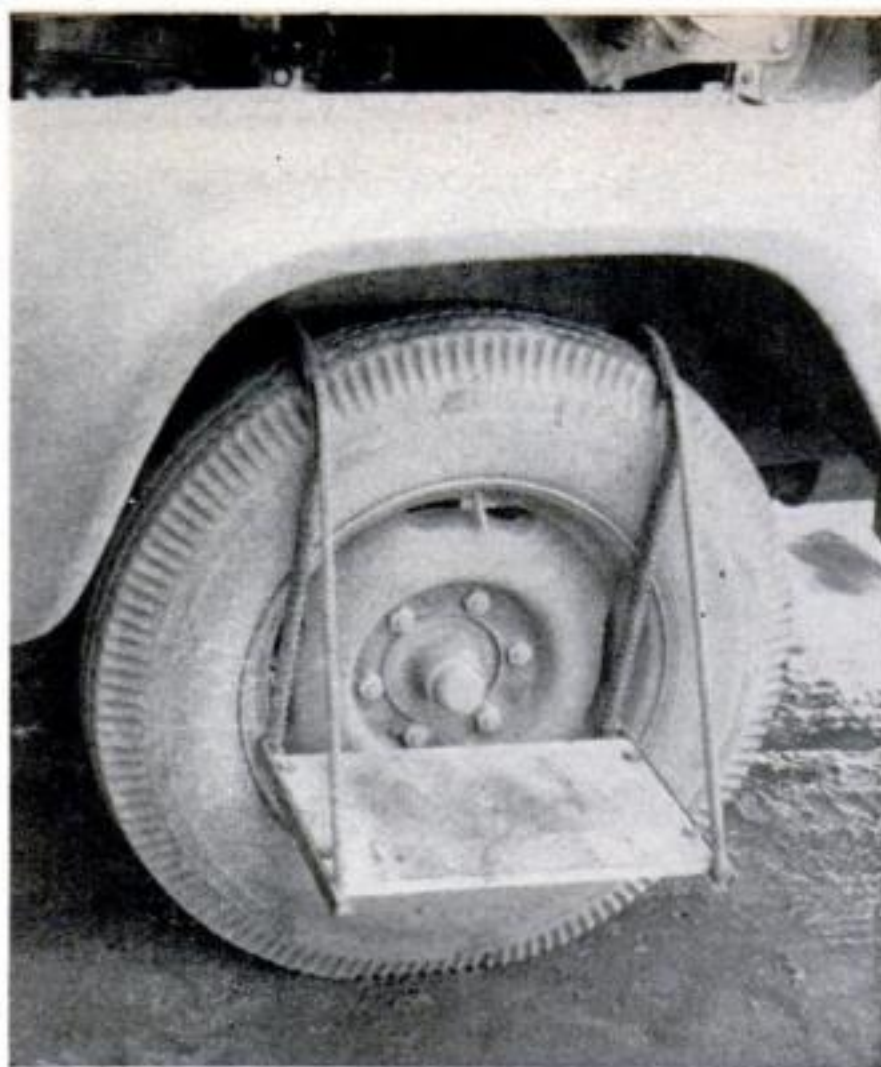
The main cause of leaky faucets has always been the grinding action of the washer against the valve seat. Inevitably, the washer wears to a point where it no longer seats tightly enough to prevent dripping. Occasionally, the packing material hardens or disintegrates until it no longer seals.

Sealing without wear. The grinding action of soft material against hard material has been eliminated. In one type of fixture, the stem doesn't raise and lower, nor does the washer rotate. When you turn the handle, a pistonlike stopper moves up and down inside a cylinder. Movement is only a fraction of an inch; wear is virtually nonexistent. Packing is replaced by a ring of neoprene, sealing water below the stem.

The other type of nongrinding faucet has a raising, lowering, twisting spindle. The foot of the spindle, however, moves in contact with a stainless-steel insert in the stopper. The stopper itself does not rotate. It just presses into the seat. Since the action is dry and lubrication simple, wear hardly exists, even after years.

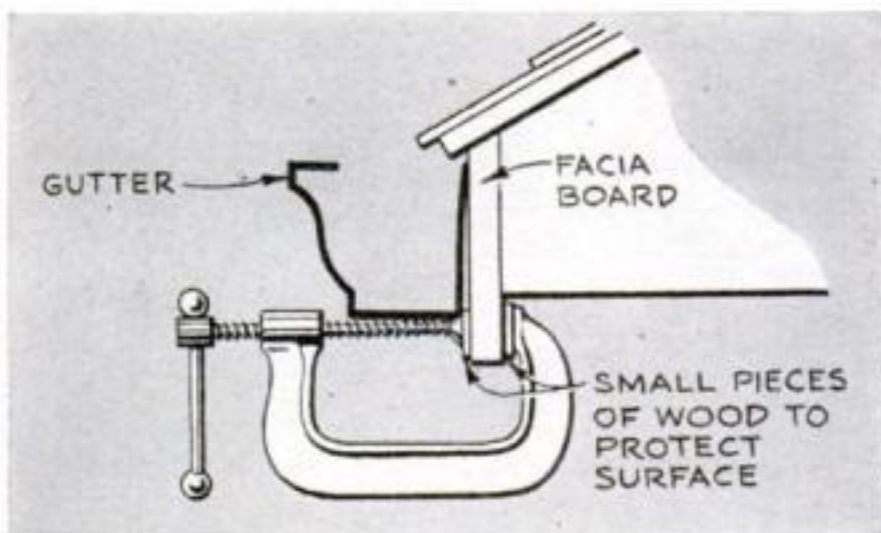
If the stopper does deteriorate, it is simple to replace. Slip a new one over the spindle and put it back together. This shaped water seal acts as both stopper and stem gasket. When you replace it, you replace everything that can go wrong.

Although repairing washerless faucets is no more difficult than taking care of the regular kind, shopping for parts is more of a problem. The stoppers are not sold at dime stores, supermarkets, or houseware departments since they are not interchangeable, faucet to faucet. But you will find repair parts at plumbing-supply outlets. Take the old part with you and you can be sure of years of good service. ■ ■



Wheel step makes engine work easier

Mechanics in the repair shop at Oklahoma State University use this wheel step for better access to the engines of large trucks. The platform is a 9"-by-18" piece of $\frac{3}{4}$ " plywood reinforced at the ends by 1"-by-1" angle iron. The step is supported by $\frac{3}{4}$ " reinforcing iron welded to the angle iron at each corner. A hook at the upper end of the reinforcing iron fits over the tire.—Dean Merrill, Ripley, Okla.



Installing gutters is a one-man job

Using half a dozen large C clamps, I was able to install 46' of eaves trough along the front of my house in two hours—single-handed. The sections were assembled with standard slip-joint connectors and then held in position, as indicated above, while I moved along, nailing them in place. Since the trough was supported, at all times, I could position it just where I wanted it.—R. V. Morford, Pierrefonds, Quebec.

REDO FLOORS, OR DOCTOR AN AILING BATHROOM

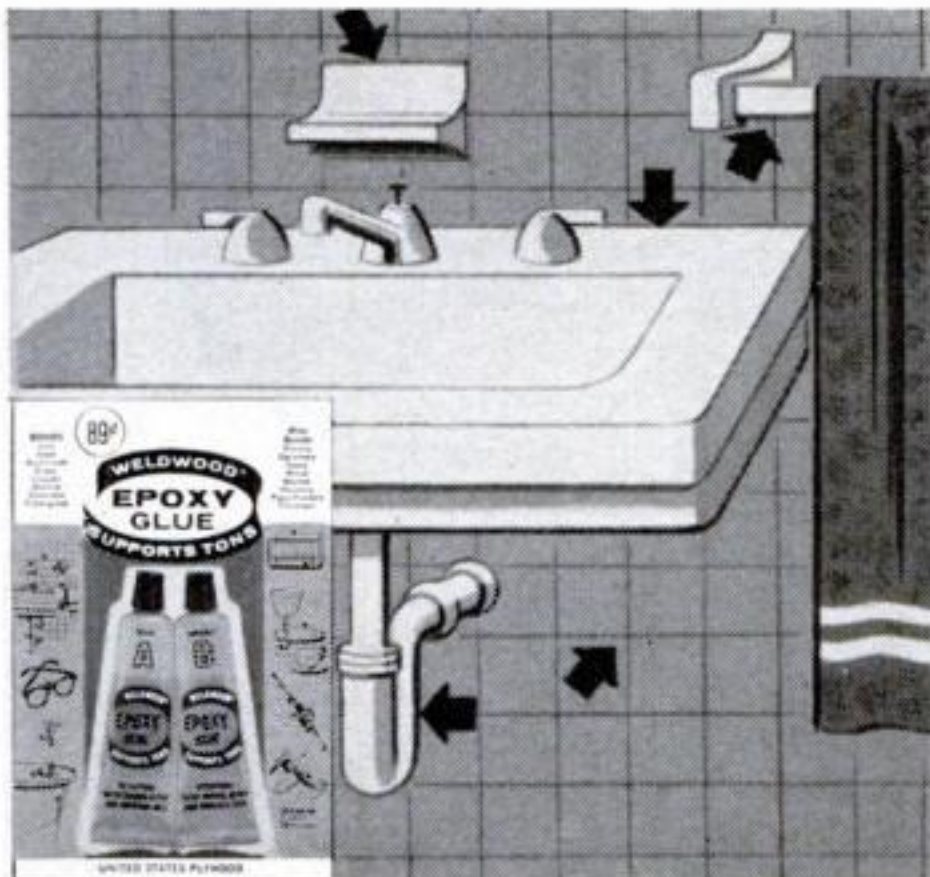
With a Weldwood
Fix 'n Finish Shelf
in your workshop



DON'T JUST RESURFACE A WORN FLOOR. Give it the protection of Weldwood® Deep Finish Firzite® that penetrates, toughens wood fibers. Wears with the wood, thus concealing wear and scratches.



RENOVATE A BATTERED DINETTE TABLE OR KITCHEN COUNTER TOP by installing a fresh, bright plastic laminate with Weldwood Contact Cement that bonds instantly on contact, without clamps or presses.



SHAPE UP AN AILING BATHROOM with Epoxy glue. You can mend a broken porcelain towel rack, fasten loose tiles, or glue a metal soap dish to tile, even stop leaks in tubing. Bonds almost anything to anything.

These three Weldwood products can be used for a thousand-and-one big or little jobs, planned or unplanned. Have them ready in your workshop against the time you are ready to tackle a job. Even an emergency won't catch you empty-handed. You'll find them at your local lumber dealer's, at paint or hardware stores. While you're at it look for the other versatile Weldwood products shown on the shelf above, to build up a complete Fix 'n Finish Shelf.



*Products of United States Plywood
55 West 44th St., New York 36, N.Y.*

Automatic camera has lens-encircling photocell

To assist the aim-and-shoot fan, Honeywell's electric-eye camera surrounds its f/2.8 lens with a photocell that automatically adjusts the diaphragm. It uses the zone focusing system to indicate the range for scenes, groups, and close-ups. As reminders, symbols for these appear in the viewing screen. Before the last shot on the roll, the word "end" appears. It's synchronized at

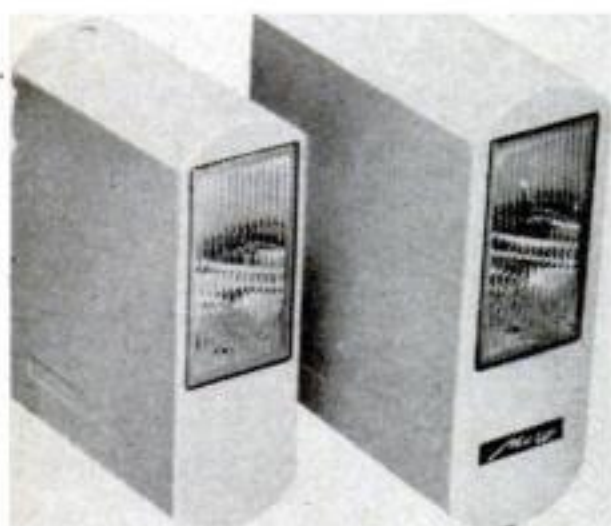


1/30 second for regular bulbs. Other features include a rapid film advance and a foldaway rewind crank. The camera lists at \$79.95. Honeywell Photo Products, 4800 East Dry Creek Rd., Denver 10.



Argus introduces a single-lens reflex

A recent addition to the Argus line is this 35mm single-lens reflex with a fast 58mm f/1.7 Sekor lens. It has a pentaprism reflex finder with a Fresnel-type focusing screen and center. Other features include a rapid return mirror, a depth-of-field preview button, and provision for an accessory exposure meter that fits the top of the camera and couples to the shutter speed dial. It retails for \$179.95. Argus, Inc., 5950 Touhy Ave., Chicago 48.



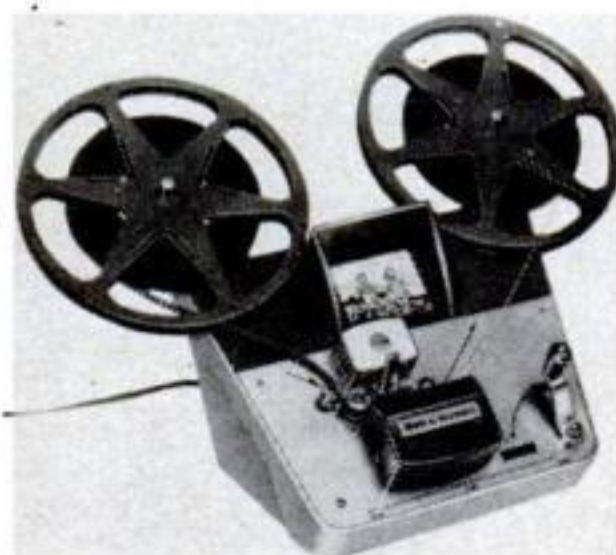
Small electronic flash with cadmium battery

These compact, one-piece electronic-flash units operate from rechargeable nickel-cadmium batteries or AC. Mecablitz 109 is \$59.95. Model 110 is \$74.95, packs twice the power. Burleigh Brooks, Englewood, N.J.



Movie light throws flood or spot

Flick a switch, and this single sealed-beam lamp throws either flood or concentrated spot beam. The Mobilite Twin Beam sells for \$17.95. Flex Electric Products, Inc., Long Island City 1, N.Y.



Film editor has its own light source

This easy-loading 8mm film editor uses a 6-volt light source behind a 50-by-70mm screen. Single-wind crank turns film forwards or backwards. It accepts 400-foot reels. Price: about \$35. Bell & Howell, Chicago 45.

**"He certainly looks
like a Johnson!"**



New Johnson Compacts

So rugged they carry a 2-year warranty!

What a happy heritage this Sea-Horse motor has. Johnson, all Johnson—since way back when. But engineered ahead of its time.

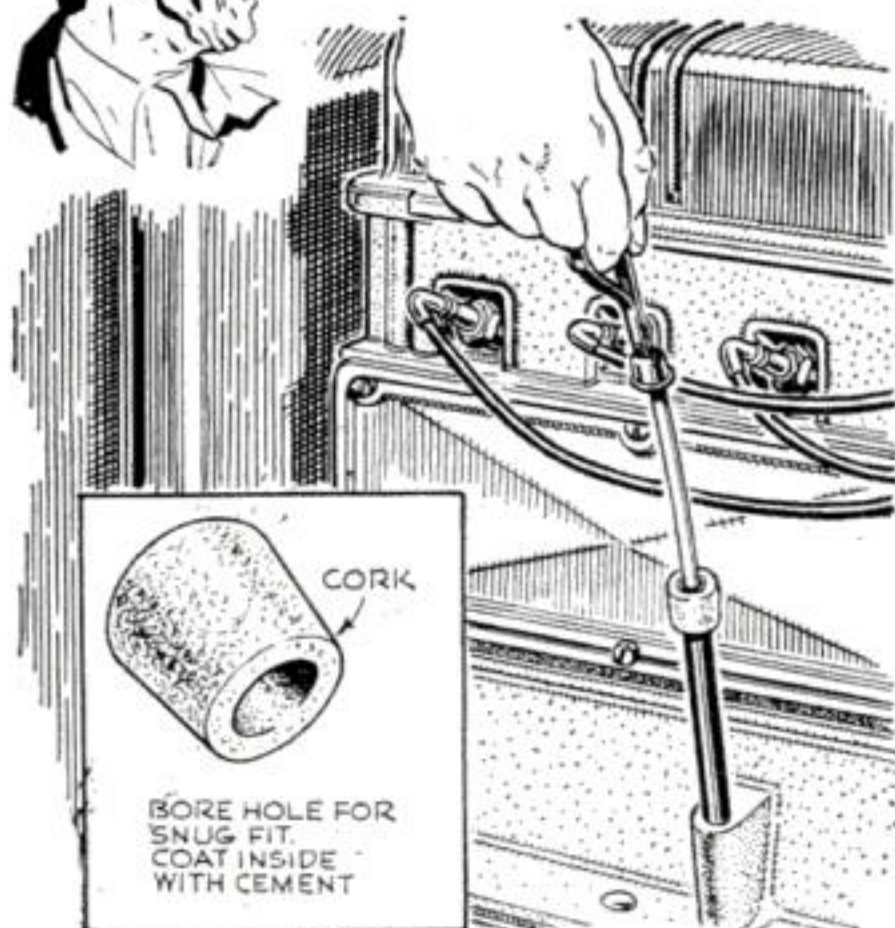
Our baby shown here is a 5½ and his two big brothers are a 10 (at right) and an 18. They're all sleek, slim and easy to handle—classic examples of Sea-Horse dependability. Each offers thermostatic cooling, a cushion-hub prop and super silencing.

The same two-year warranty policy — *good for parts and labor* — applies in every horsepower class: 3, 5½, 10, 18, 28, 40 and 75. For free catalog, write Johnson Motors, 1362 Pershing Road, Waukegan, Illinois. Division of Outboard Marine Corporation.

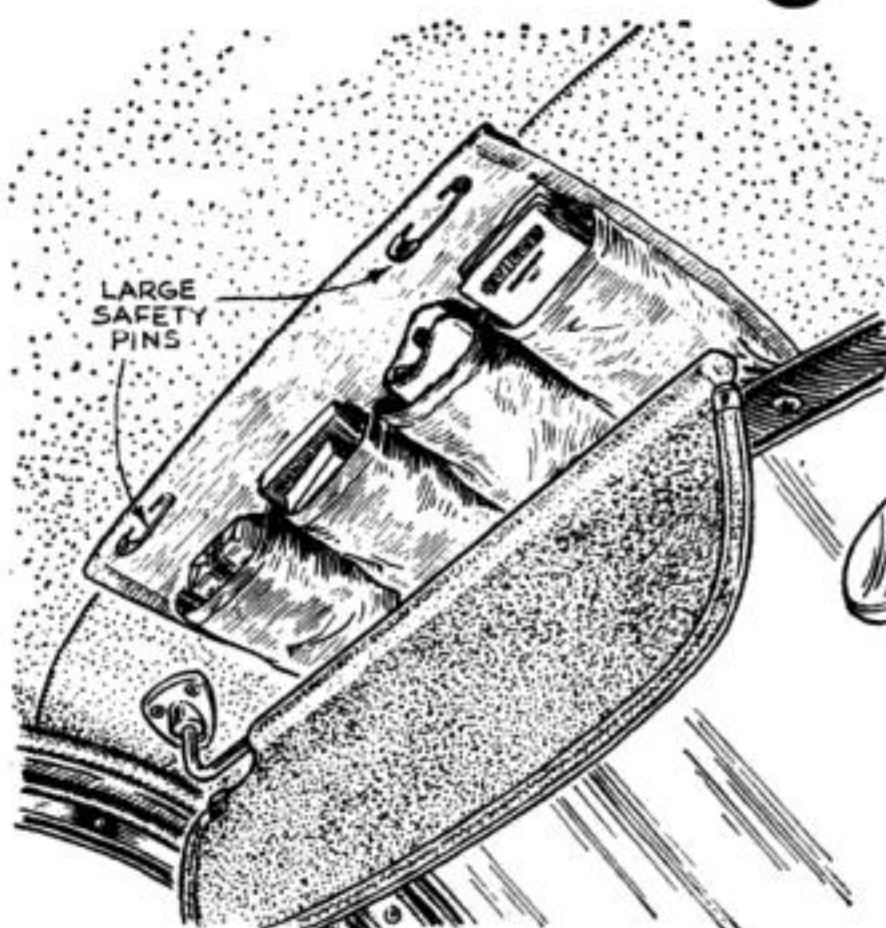




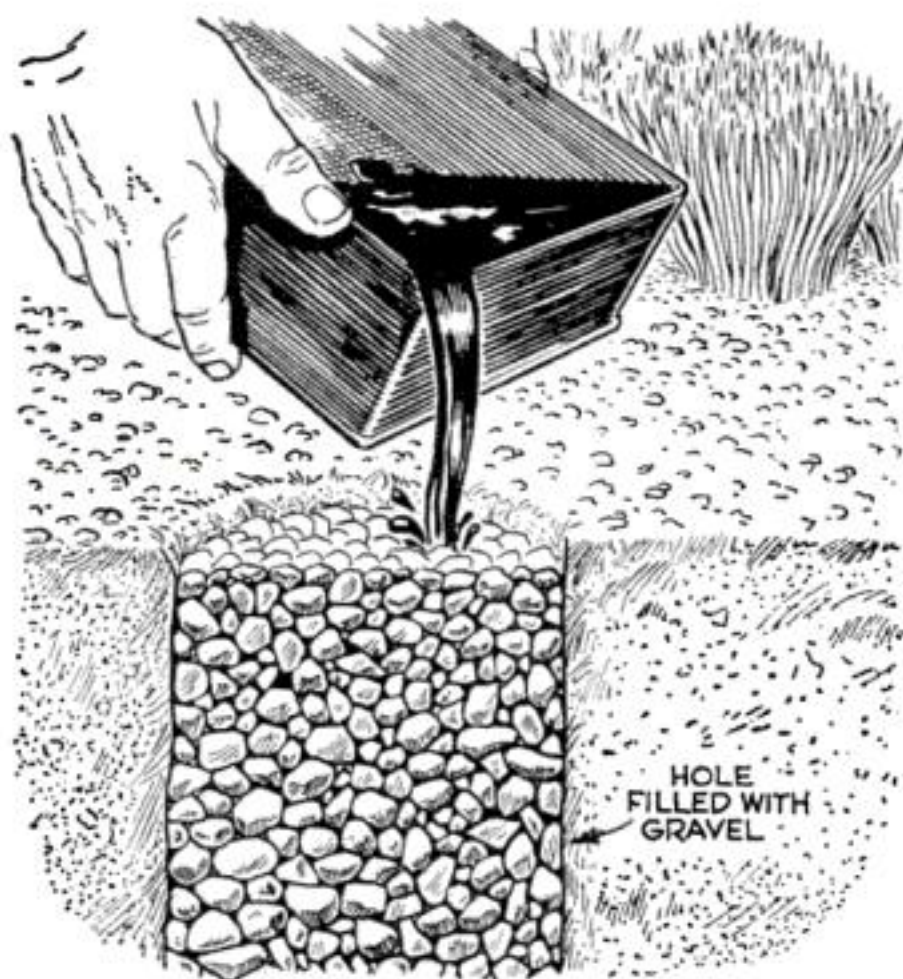
Hints from the Model Garage



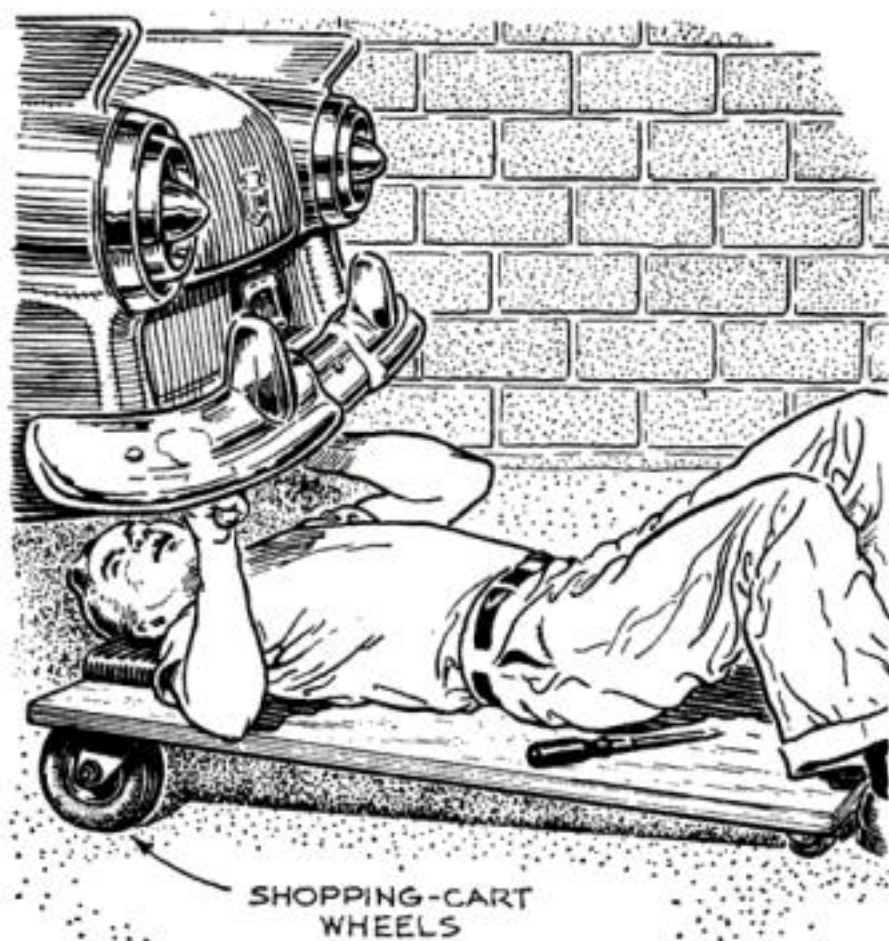
A cork stopper speeds up oil checks on engines in which the dipstick tube is hard to see. Instead of groping or using a flashlight, paint the stopper white, drill a hole through it, and cement it in place over the end of the dipstick tube.



A holder for maps, sunglasses, and other small items can be made from a cut-down shoe bag. Restitch the pockets so items can't slip out. Pin the top edge to the headliner with safety pins. Secure the bottom under the window molding.



Disposing of used engine oil can be a problem. Solution: Dig a hole in the ground with a posthole digger and fill it with fine gravel. Then pour in the oil. It will be absorbed into the ground before your next change. Cover the spot with soil.



To make a creeper more maneuverable while you're working under a car, replace the small casters at the front (pillow end) with larger wheels. A pair of swivel wheels like those on a shopping cart can be adapted easily for this purpose.

Nationwide study of 10,000 cars reveals major cause of winter starting trouble

On a cold or damp morning, does your car grind away helplessly—while your neighbor's car starts right away? To find the reason, the ignition systems of some 10,000 cars were analyzed. Whether you live up near Duluth or down in Dixie, the following facts from the study can make your morning motoring easier . . .

On the first day of each of the year's four seasons, in some 300 cities spotted all over the nation, ignition systems of cars pulling in for refueling were carefully analyzed. Distributors, spark plugs, cables, coils and condensers all received attention. In all, more than 10,000 cars were studied.

1 in 4 report hard starting

As part of the study, on the first day of spring motorists were queried about starting trouble during the just-ended winter, while facts were still fresh in their minds. Slightly more than one in every four (26.7% of them) reported hard starting.

Surprisingly enough, winter starting trouble was almost as great a problem in the south as in the north. In Arizona and California, for example, the incidence of hard starting was *right on the national average!*

What about batteries?

The study showed that battery age did not seem to be nearly as important as you might think. While you may have called your service man to tell him, "My battery's dead and my car won't start," it's more than likely your battery went dead trying to coax an engine-igniting spark out of worn and weary plugs.

Worn spark plugs key factor

The study showed that hard starting might be due to any of several factors—but it clearly showed the major cause is worn spark plugs! (Plugs with over 10,000 miles on them.)

The figures showed that only 12 out of every 100 cars that started the winter with good plugs experienced hard starting. But of those that started with worn plugs—41 out of every 100 had starting trouble!

The study also showed that as plugs piled up mileage and became more worn, starting trouble occurred more and more often. Surprisingly enough, it was found that plugs are generally in their worst condition at the beginning of winter, when good plugs are needed most.

Why more trouble in winter?

Why does your car have a harder time getting going on a cold or miserably damp morning? Because it takes more battery energy to spin the hard-to-turn engine. And it also takes more voltage to flash a spark across chilled spark plug electrodes. This is why worn plugs cause trouble. As wear makes the sparking gap bigger, more voltage is needed for sparking. And the need increases sharply as the gap widens.

That's why your neighbor's car may start when yours won't. His spark plugs are probably in good condition. The extra voltage needed for firing your worn plugs is, in effect, the straw that breaks your battery's back. The result: Hard starting at first. Later, probably *no starting!*

What's the remedy?

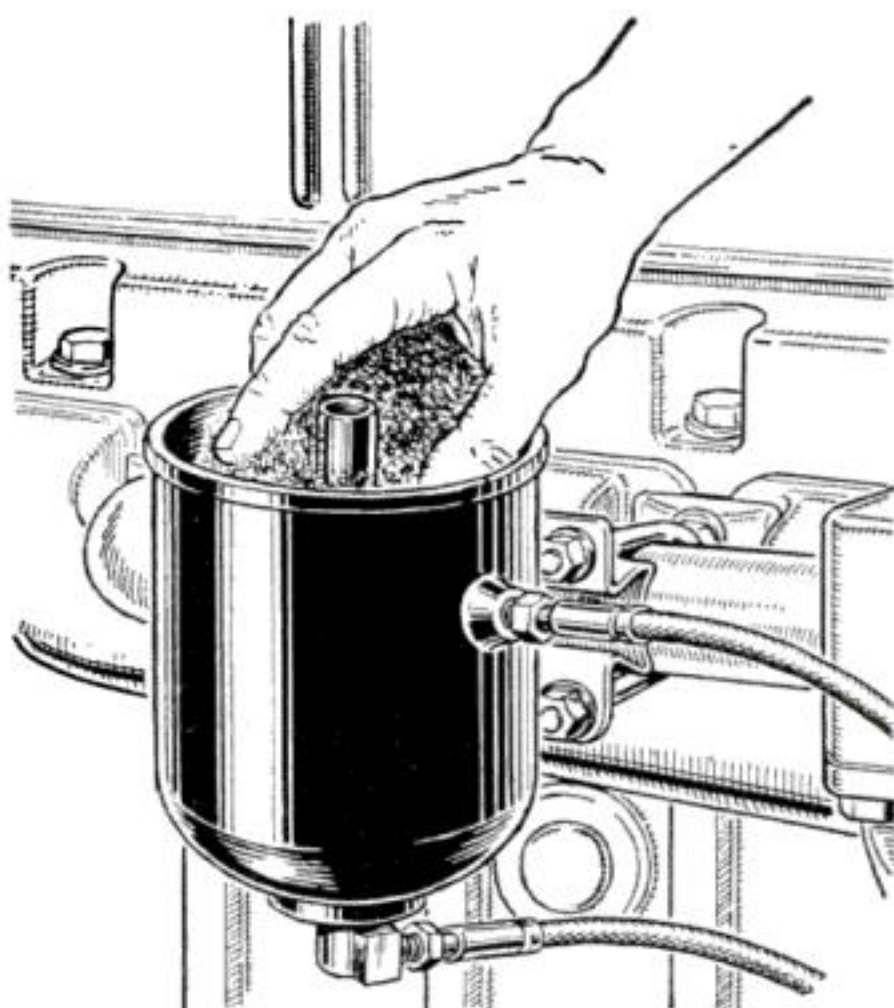
If you didn't start the winter with new spark plugs in your engine, have them installed now. And ask for silvery-plated Champion spark plugs. New Champions make any car start easier and run better. That's why they're first choice with engine experts everywhere. Don't settle for less in your car. Always specify Champions.



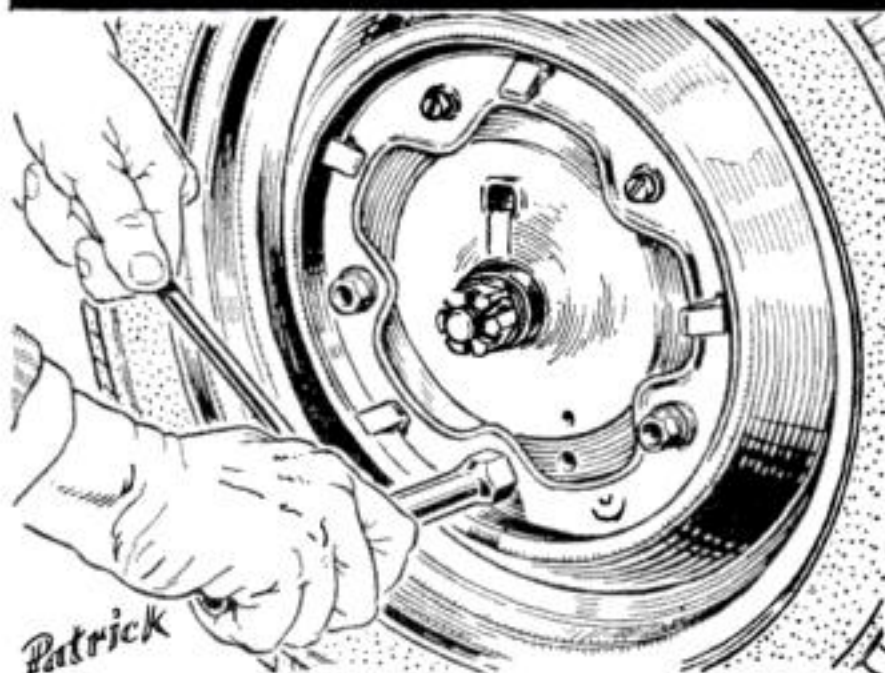
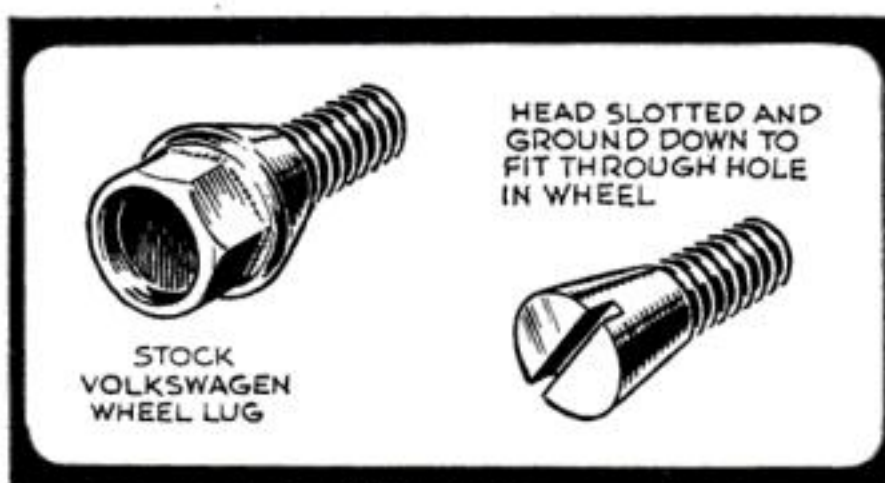
CHAMPION

CHAMPION SPARK PLUG COMPANY • TOLEDO 1, OHIO

More Hints from the Model Garage

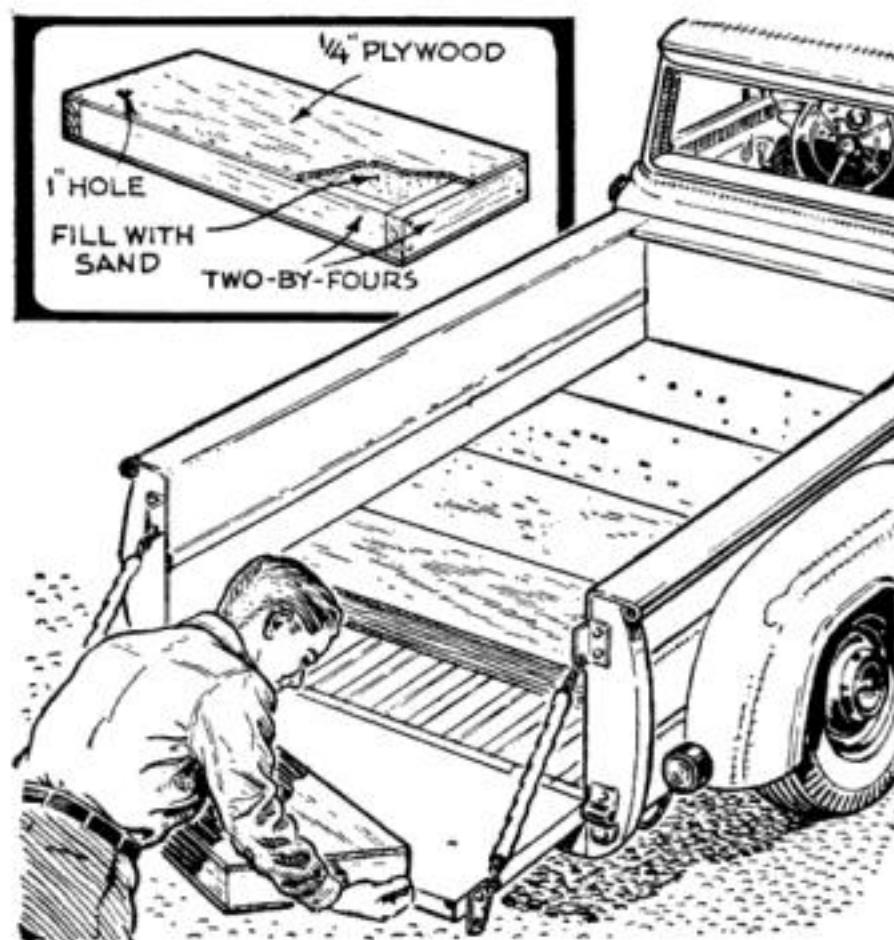


Cleaning sludge from an oil filter is easy with highly absorbent lint salvaged from a clothes dryer. Wad the lint into a ball and push it down into the filter. When the oil is soaked up, wipe the inside of the filter clean with a lint-free rag.

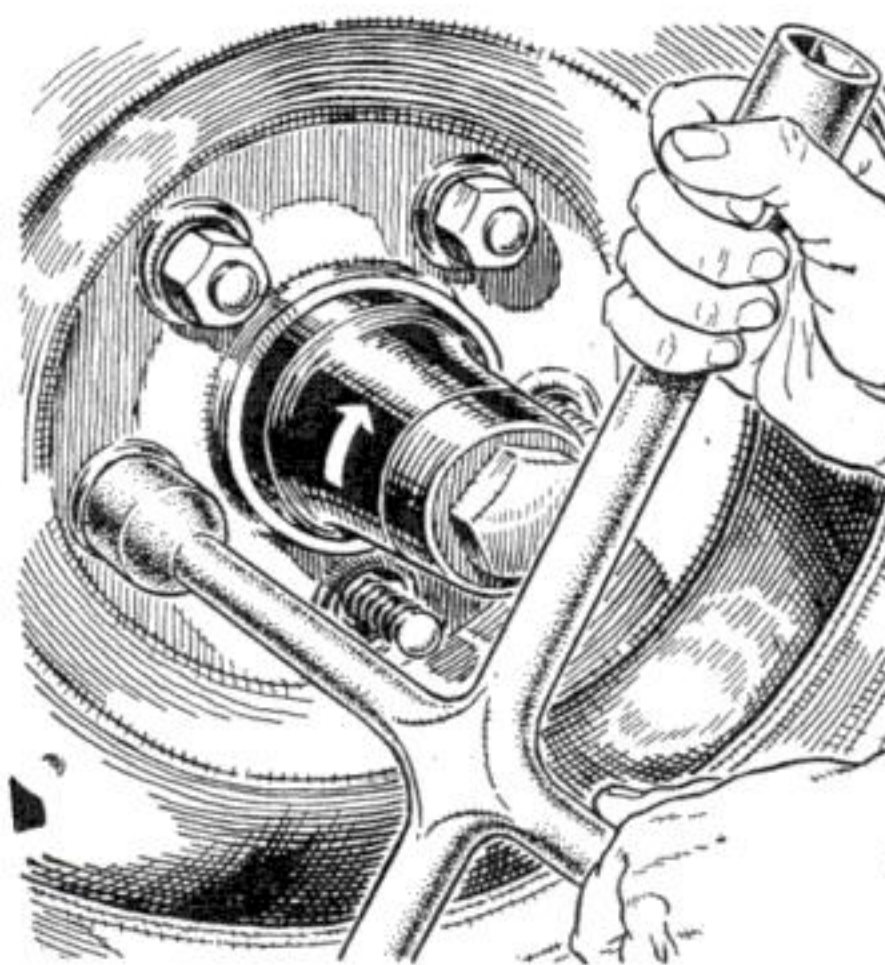


Patrick

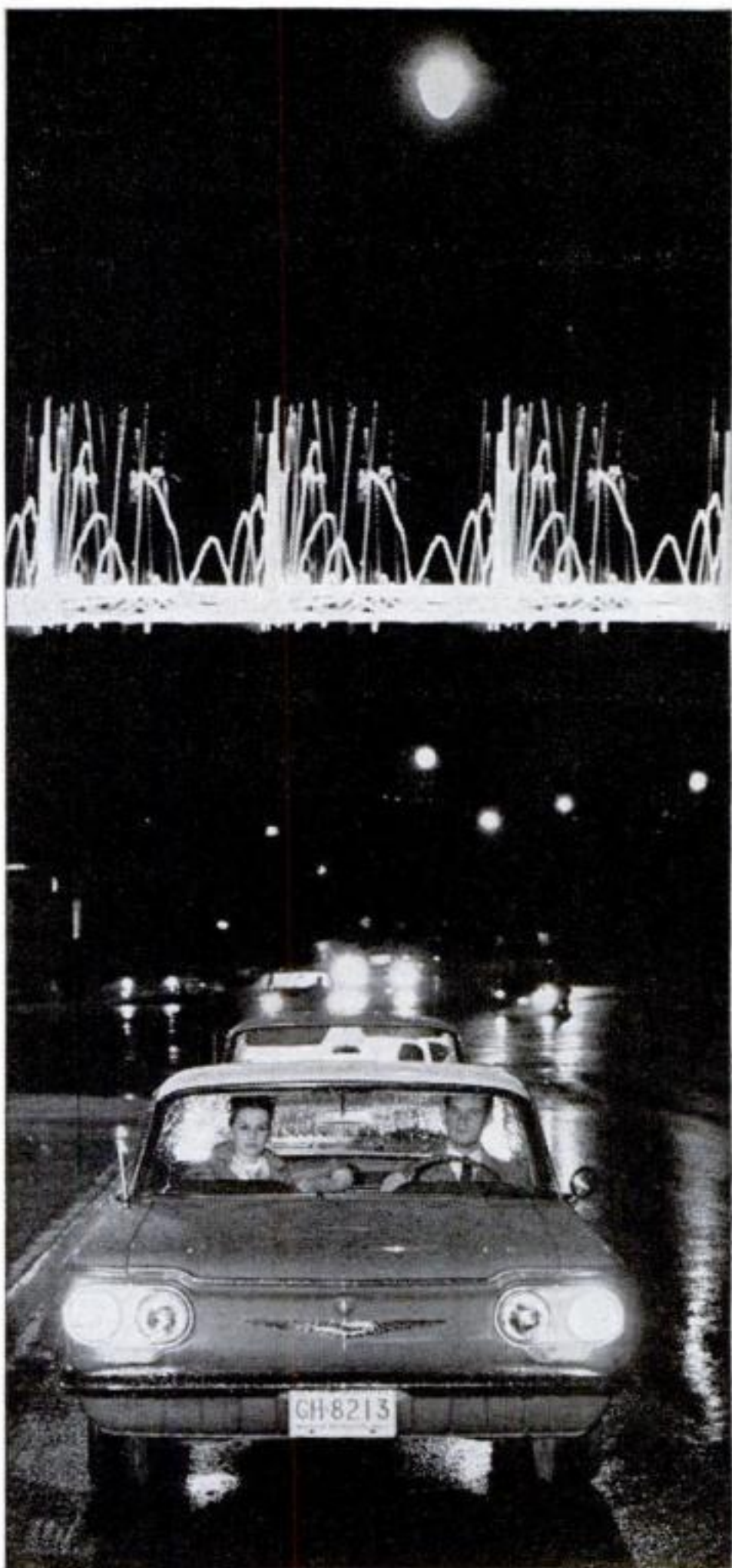
VW brake drums have no studs for positioning a wheel when changing tires. You can make temporary ones by grinding down two extra wheel lugs. Saw screwdriver slots. Before removing wheel, temporarily replace two lugs with the screw-in studs.



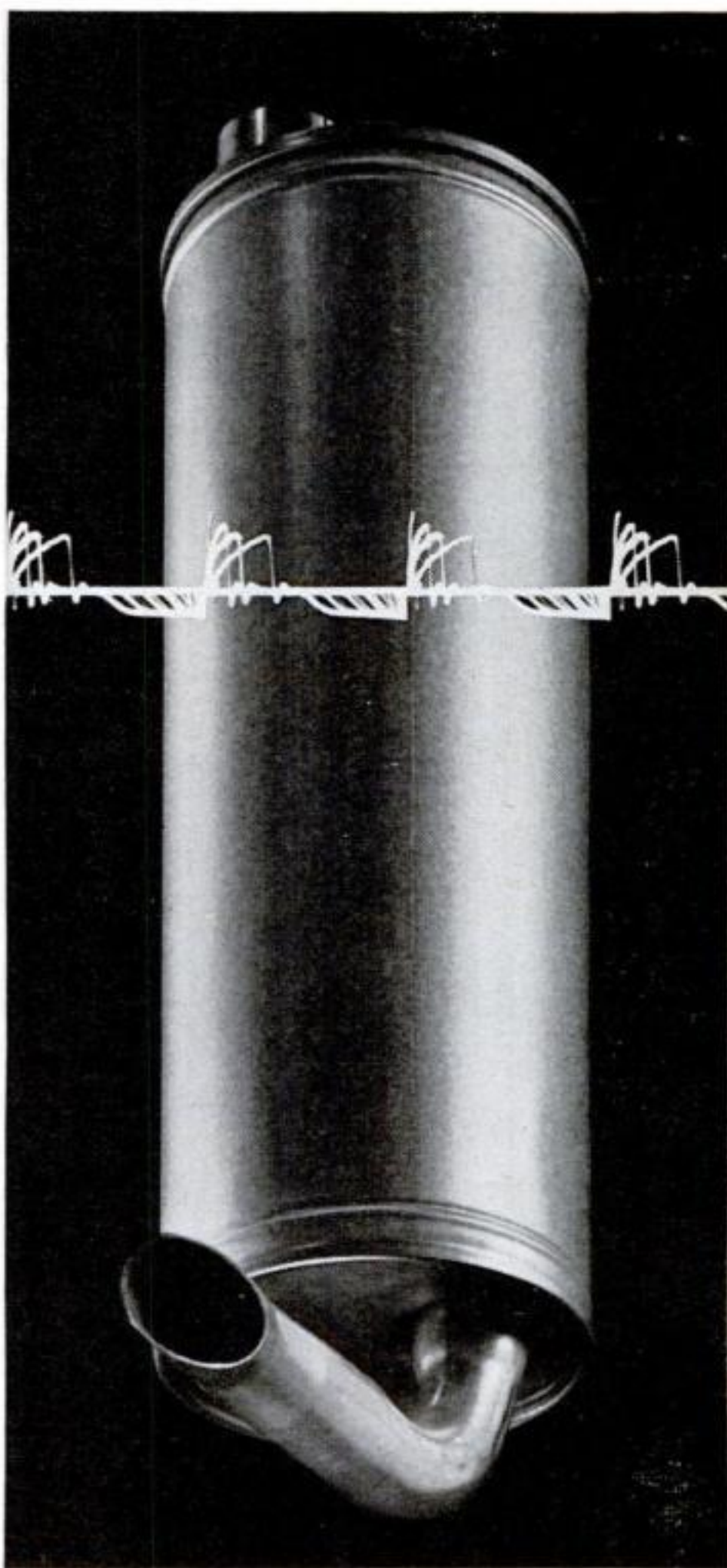
Need ballast in your pickup truck when it snows? Five of these sandboxes take up little space, and they won't slide around. Tops and bottoms are 1/4-inch plywood; sides are two-by-fours. A one-inch hole in the top of one lets you use sand on ice.



Small arrows painted on axle hubs will remind you to turn the lug bolts in the proper direction when you're changing a tire. This is particularly handy on cars that have a left-hand thread on one side and a right-hand thread on the other.



sound



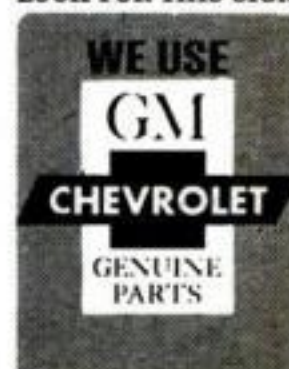
quieter

Doesn't it make sense to replace a noisy muffler on your Chevrolet with a *genuine* Chevrolet muffler that was specifically designed for your car? It's built to fit right and work right. Built to Chevrolet quality specifications to give you long, trouble-free service. Whatever you need, Genuine Chevrolet Parts are available at your Chevrolet dealer's and, of course, at leading independent garages and service stations. Ask for them by name.

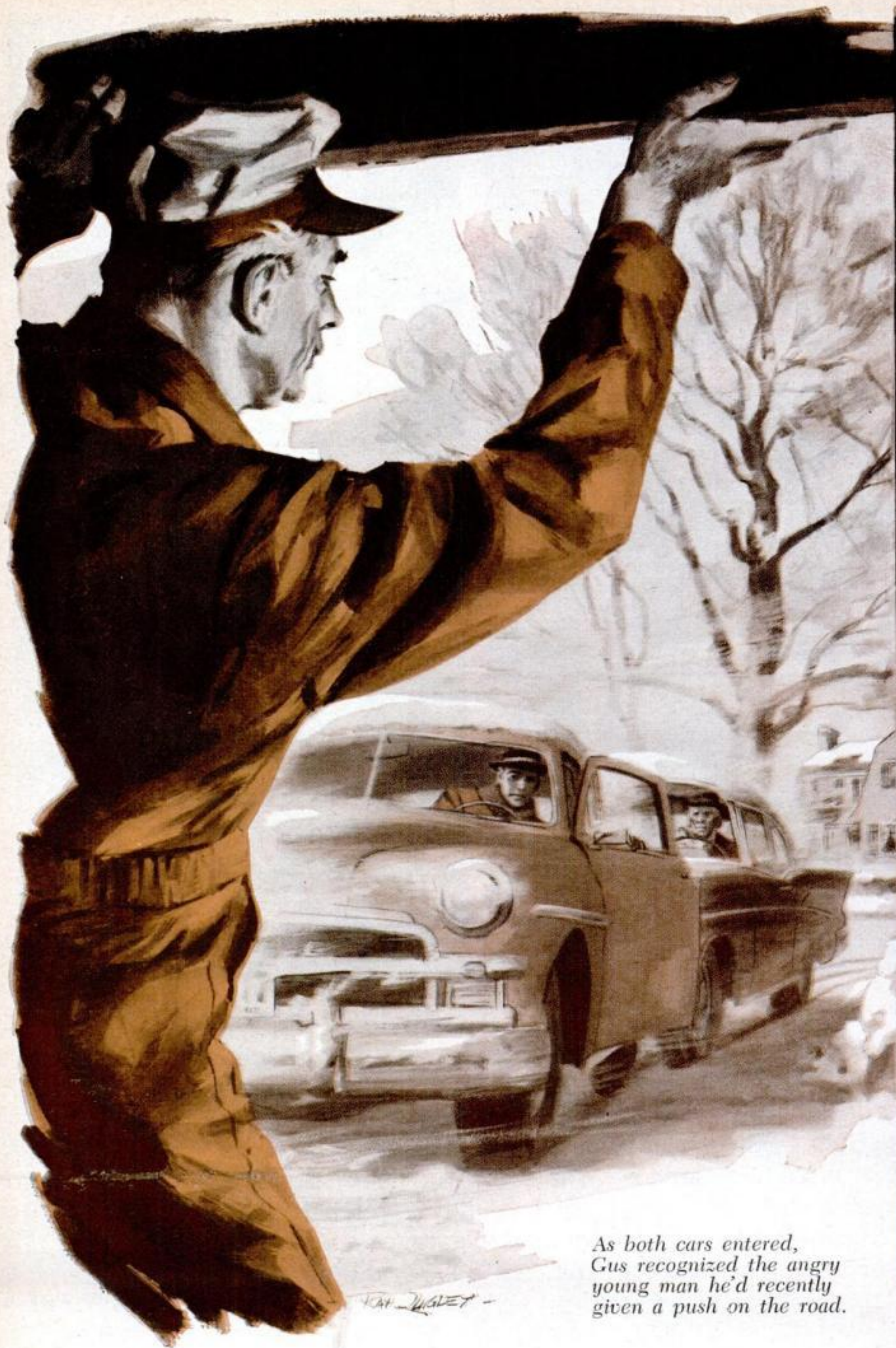
Chevrolet Division of General Motors, Detroit 2, Michigan.

When you want your Chevrolet to sound like new, ask for **GENUINE CHEVROLET REPLACEMENT PARTS**

LOOK FOR THIS SIGN



**IT PAYS TO KEEP
YOUR CHEVY THE
CHEVY-EST**



As both cars entered,
Gus recognized the angry
young man he'd recently
given a push on the road.

Gus Follows a Cold Trail

By Martin Bunn

ICE slicks on the road, and snow that thickened on laboring wipers, made Gus Wilson slow prudently for the turn off the dead end of Route 80. It was cruelly cold, and even the full blast of the heater made the car only bearable. With relief he swung onto a county road that led to town and the Model Garage.

He had just picked up a little speed when he spotted a stationary car ahead. Checking his mirror, he pulled out to pass. Then he saw that the car wasn't standing, but being pushed by a snow-flecked, plodding figure. Gus stopped behind it, set his turn signals blinking to warn following cars, opened his window, and leaned out.

"Want a push?" he yelled.

The figure straightened up, revealing a young man's face that was a blend of exhaustion, exasperation, and determination in equal amounts.

"Guess I can handle it myself, mister," shouted the young man, as if he were mad at Gus. Then he mellowed. "Well, okay. Let's give it a try."

Gus nodded. The stranger got in and Gus nudged the bumper of his coupe against the other car. At 20 miles an hour he felt the driver engage the clutch. The engine caught, made a few revs, and died. Gus reclosed the gap between them and again nudged the car into motion.

This time the engine chugged over longer: It caught at last with a small backfire, and kept running. The car pulled away, maintaining what speed the icy road permitted. It stayed ahead all the way to town. At the first light, the driver pulled to the curb and rolled down his window.

"Guess it'll run long enough to get me where I'm going," he called out as Gus stopped alongside. "My boss insists I take

it to some local genius he swears by. I don't think this joker can fix it even if he is a genius, but I've got to let him try. Anyway, thanks for the push."

"Welcome," said Gus. "Good luck."

Back at the Model Garage, Gus found the day's work nearly done and no new jobs in. He was about to tackle some office chores when from the street came the squeal of hastily applied brakes. An instant later followed the expected crunch of metal on metal.

"Business, Boss," remarked his assistant, Stan Hicks.

"The kind I'd rather do without," said Gus. "Hope nobody's hurt."

Both went to the door. Through the falling snow, two cars could be seen standing askew in the street intersection. A door of each hung open. Two men circled about, looking for damage, and a wordless murmur reached Gus and Stan briefly.

Then both men got into their cars. Starters whirled. One engine fired; the driver of the other car made sweeping gestures as his own engine died. The first backed jerkily, swung behind the other, and lunged forward. Its driver braked barely in time; the bumpers met with an audible smack.

"*They're coming here,*" said Stan. "I think one is Judge Benson's car."

The other car also looked vaguely familiar to Gus, who rolled up the big shop door. As the cars entered, he recognized the angry young man he'd given a push on the road a short time before.

"Hello, Gus," said the retired judge rather sheepishly as he got out. "Did you see what happened back there?"

"Heard it, Ben," returned Gus, looking the cars over. "No glass broken, no dents. Guess only the two bumpers hit."

CONTINUED

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The young man nodded. "I was feeding gas to get across when my engine quit again. Fact is, I was headed for this place. Hey, it's—are *you* Gus Wilson?"

"Only name I've got," said Gus.

The young man opened his coat and shook the snow off. "It's a small world. You know my boss, Steve Hacket. I'm Jim Dwyer. We're doing a final check of the survey of Route 80. I needed a car to get around fast. Got this one below book value, 'as is.'"

"It ran fine the first four days. Then it suddenly felt like somebody'd swapped the engine for something out of a lawn mower. No pep. Quit at lights and on hills. The first mechanic said it was dirt in the carburetor, but as the car was running again it must have cleared itself. He blew out the gas line and it worked okay. Nine days later it conked out when I was rushing to the courthouse for some important data."

"Anybody check for ice in the carburetor throat or gas line?" asked Stan.

"The second mechanic thought of that. He dumped in de-icing fluid. But car trouble made me late on the job twice. Another mechanic put on a new carb, flexible fuel line, plugs, coil, and distributor. No good."

"No fuel pump?" asked Gus.

"Checked that three times," said Dwyer sadly. "Everybody thought it was okay, but finally I did put on a new one."

"Then my troubles really began. I got stuck out in the field hunting up some survey markers. Took me hours to get back. Our schedule's all shot. We're supposed to have the whole survey checked out and approved by next week, and it's mostly my fault we're late. This morning Hacket told me to bring you the car and get it fixed, or get off the job."

Taking a droplight, Gus rolled under the car. Muffler and tailpipe showed no sign

of exhaust leaks to account for a vapor lock. He wriggled out and raised the hood, then pulled the gas line off the carburetor. Cranking the engine brought a steady flow of gas from the fuel pump. Gus replaced the line and pulled the fuel line off the pump at the gas-tank side as Stan brought over an air hose.

Gus held the hose to the line and touched the valve. A bubbling of air in the tank could be heard plainly.

"Everybody tried that," said Dwyer. "We know the gas line's clear."

"Do we?" asked Gus. "Let's check it another way. Stan, plug the filler."

Stan removed the filler cap and held a sponge-rubber ball firmly on the neck. Again Gus cautiously applied air to the line. Metal twanged and creaked as pressure built up in the tank. Gus removed the air hose.

With air pressure behind it, gas should have gushed from the line. Instead there was only a dribble. Gus applied the air hose again, even more briefly. As he re-

moved it, gas trickled past his fingers. Then, with a sudden spurt, it became a fast stream. Something came through the line and fell into Gus's hand.

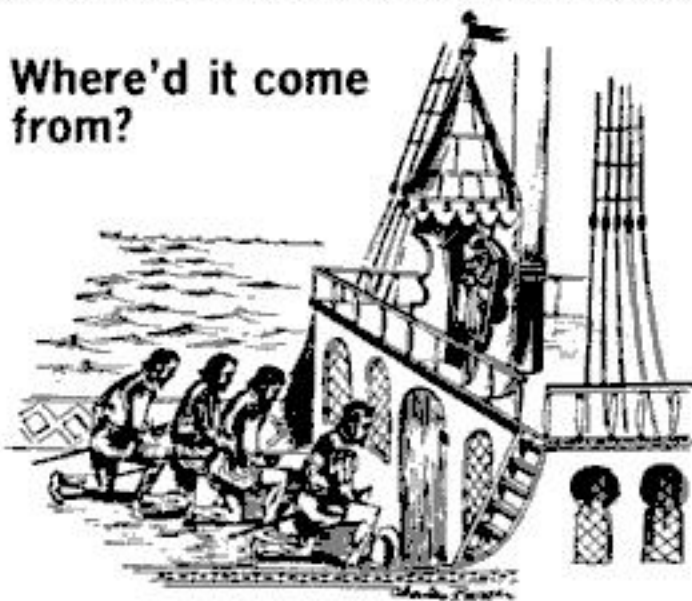
"Let go, Stan." The stream ceased as Stan removed the ball. Gus held his hand out to Dwyer. In it lay a small wedge-shaped bit of rubber.

"There's your trouble. Could be a piece of a gasket or door seal. It got sucked into the line, then jammed at a bend or flattened spot."

"Then how come air got by it?" asked Dwyer.

"See how soft it is? With the sharp end toward the tank, air going that way just pushed this flap away. But gas going the other way jammed the thin lip back, blocking the line. The more gas flowed, the lighter the squeeze. That's why the engine

Where'd it come from?



"Poop deck"

The raised afterdeck of a ship at one time held a small image of a saint set in a shrine attached to the mast. The Latin word *pupa*, which means small child, doll, or puppet, first was used to distinguish this deck, and later evolved into poop deck. It sometimes covers a cabin.

END HIDDEN DANGERS OF FRONT-END SAG



"Bottoming" on bumps and potholes is eliminated by Front Load-Leveler stabilizing units.



Rolling on sharp turns and "wind sway" ended with stability of Front Load-Levelers.



Wheel shimmy at high speeds is ended with Front Load-Levelers holding wheels in alignment.

WITH NEW MONROE *FRONT* Load-Leveler® STABILIZING UNITS

Front-end sag takes its toll on *every* car. It begins when springs take a "set," and changes the entire geometry of your steering system. Wheels continually get out of line, and shimmy at high speeds. Tires are virtually destroyed. Steering becomes difficult. Control of your car is dangerously reduced. Now you can end front-end sag, without costly spring repair, make your car ride *better* than brand new, and prolong tire life with new Front Load-Leveler stabilizing units by Monroe. Installed in place of your present front shock absorbers, Front Load-Levelers give firm support to sagging springs and compensate for "set." They give your car extra stability, for sure-footed cornering and a safer, more comfortable, more economical ride. You'll marvel at the improved roadability you'll get with new Monroe Front Load-Levelers. Have a set installed in less than thirty minutes where you have your car serviced.



LOOK FOR THE MONROE DEMONSTRATOR BARREL!

World's largest maker of ride control products including Monro-Matic® shock absorbers.



MONROE AUTO EQUIPMENT COMPANY, Monroe, Michigan • In Canada, Monroe-Acme Ltd., Toronto, Ont. • In Mexico, MEX-PAR, Box 28154, Mexico City

would idle, but quit when it pulled more gas. A new pump with more suction only made things worse.

"Just in case there's more junk in the tank, you'd better drain it, Stan," added Gus as he replaced the fuel line. "Most people never do. Then some cold morning they wonder how ice got into their gas line. First thing you get out of any tank you drain is water. It condenses out of humid air all summer, sinks to the bottom, and finally gets into the line."

"I'll be back for my car," said Dwyer,

The frown on Benson's high forehead took on new wrinkles. "Can't understand it, Gus. Why, it was still racing when I shoved that other car in, and I had trouble doing that gently. In this cold weather it usually runs fast much longer than in warmer weather."

"In cold weather?"

"Ever since this zero spell set in."

Cutting the engine, Gus removed the air cleaner and nudged the wide-open choke with a finger. It swung right back, proving that the thermostatic spring was intact, choke shaft and vacuum piston free. The fast-idle cam moved with it; its stepping quadrant was clean, the fast-idle screw in the throttle arm correctly set, throttle linkage free.

Gus thoughtfully took his droplight into the driver's compartment. Twin puddles gleamed on the floor mat as he worked the throttle pedal. It was also quite free, but he fingered the hinge on which it worked. It was moist.

"Your garage is unheated, isn't it, Ben?" asked Gus, leaning out the open door.

"Sure. But what difference . . ."

"We've had a lot of snow underfoot right through this nippy spell."

Benson's heavy jowls worked impatiently. "Don't need a weather report, Gus. I want my car fixed."

Gus had brought two oil cans over from the bench. He bent over the floorboard.

"It is fixed, Ben. You've been getting in the car with snow on your feet. It gets into the hinge of the gas pedal, then refreezes overnight. By morning that ice binds the pedal, holding it part way open once you've pushed it down, until the heater warms up and melts it. Here in the warm shop it melted while we fixed Dwyer's car."

"Okay, okay. So fix it," retorted the judge testily.

"Done all I can," returned Gus. "I shot some alcohol into the hinge to melt any ice left, and oiled it. The rest is up to you."

"Me? I don't know a thing about cars, Gus Wilson," spluttered the judge, "and you know it. What d'you expect me to do?"

"One little thing before you get in the car, Ben. Wipe your feet!" ■ ■



"Hi, Betty! Hop in!"

taking out a bill. "Here—maybe this will cover turning a lemon sweet—and thanks."

Judge Benson, who had been contentedly warming himself at a radiator, thoughtfully watched Dwyer leave, then turned his grizzled, heavily jowled face to Gus.

"Know what, Gus? I'm an old fraud."

"Anybody who's seen you bluff at poker knows that. What else is new?"

"I mean about that accident. He did stall, but I stopped too late. Why? Because my fast idle's stuck. Every time I've gone out lately, the engine races for two, three miles. With an automatic transmission, that gives me mighty poor control."

"It sure would," agreed Gus. He started the judge's six-year-old car. It settled at once to a sedate idle. Gus opened the hood. The fast-idle cam was swung out of the way, as it should have been with a warm engine. When he opened the throttle by hand, it promptly returned against the slow-idle stop.



What does it take to feel like a man?

It takes action to feel like a man. Takes pride and courage. But in today's modern world *it also takes training. Technical training.* Ask any mechanic. Ask any missile man.

In today's modern Army all units are fast-moving. Flexible. Men and machines are closely interlocked. And since the machines are complex, men have to be extra skilled to handle them. The Army *makes* men like this—technically skilled, competent, confident.

The training you get can give you a good future. Almost unlimited. You can be expert in areas like engineering, missiles, electronics, motor mechanics—or any of 150 other fields!

And of course you have other choices too. Want *Combat Arms*? Then ask for Infantry, Armor or Artillery. It's as simple as that. If you're qualified, your choice is *guaranteed before you enlist*. Find out how to feel like a man in today's fast-changing world. See your local recruiter today.

How to Get Started in Gas Welding

[Continued from page 130]

to make the customer more likely to return tanks for refills to the firm that sold them rather than to a competitor. If you encounter this dodge, shop around. Why lease if you can buy for the same price?

The total cost, then, of a least-expensive ready-to-go oxyacetylene welding outfit runs to \$148 (\$70 for torch and regulators plus \$70 for 60-80 tanks plus \$8 for gas). Any other equipment you'll need you can build yourself. It's convenient to have a small firebrick-topped table to weld on. And a wheeled truck for your gas tanks makes your outfit easily portable.

You'll find detailed instructions for setting up your outfit in the handbook packed with your torch. It's important for safety's sake to be sure that all connections are gas-tight. To be certain, brush all fittings with soapy water and watch for bubbles.

The instruction book will also list some safety precautions, of which these are particularly important:

- See that the area in which you're welding is well ventilated. Welding some metals produces noxious fumes.
- Beware of grease and oil, which in the presence of pure oxygen can break spontaneously into fierce flames. Never oil any part of your welding equipment. Never wear greasy clothing.
- Trying to weld any closed container that has held solvent, gasoline, paint, oil, or other flammables is sheer idiocy. Since it's impossible, without special cleaning equipment, to remove the last traces of vapor from such containers, they're apt to explode violently if heated.

Using the torch. When you've read the instruction book through, practice with your torch a little on scrap mild steel, remembering these three points:

1. Keep the flame properly adjusted. The test of proper adjustment is the way in which the molten metal acts. You'll see this immediately if you fuse three puddles of molten metal in scrap steel. Melt one with an excess-acetylene flame, one with an excess-oxygen flame, and one with a neutral flame. Use around five pounds' gas pressure.

The steel puddled with the excess-acetylene flame will cool rough and brittle. You'll see the white fringe at the end of the flame's luminous inner cone that welders call "acetylene feather." The steel puddled with the excess-oxygen flame (the luminous cone is

smaller and the flame hisses) will look "burned"—porous and slag-covered. An oxidizing flame is the cause of most poor welds. Whenever you see whitish slag floating on the molten metal, you're using too much oxygen.

The puddle melted with a neutral flame will lie as still and bright as heavy syrup. When cool, the metal will be smooth and clean.

2. To weld a seam, fuse a puddle of molten metal deep enough to penetrate to the bottom of the joint. Metal thicker than $\frac{1}{8}$ " should be beveled on a grinder. Then ease the molten puddle along the joint, adding filler rod as needed. Inclining the torch 60 degrees in the direction of travel and swirling the flame in small circles gives the weld a neatly finished bead.

3. Watch expansion and contraction. When welding long seams, first tack-weld the work every few inches, then weld the seam in short sections to avoid warping and buckling the steel. Fusion-welding nonferrous metals is accomplished similarly, using special rods and special flux to control oxide formation.

Flux is also required for brazing and bronze-welding. Since, when brazing with silver or brass rod, you're working at a lower heat level than when fusion-welding, use the outer part of the torch flame to heat the work. Bronze-welding is like brazing, but at higher heat. This diffuses the bronze into the steel being welded and yields a stronger joint. It's the easiest way to repair broken iron castings.

With a small cutting tip on your torch and a hand steady enough to direct the oxygen jet, it's possible to burn unbelievably intricate shapes in steel plate. You can also use your torch to cut aluminum or brass—not with the cutting tip but with a welding tip. The trick is to paint a stripe of heat-resistant iron cement along the line to be cut, then simply melt off the metal beyond the cement.

As you discover new uses for your versatile 6,300-degree flame—bending and forming, hard-surfacing, filling, heat-treating, building-up, and a hundred others—you'll appreciate it all the more. If you're the sort of guy who likes to build things you could take out and sell if you wanted to, an oxyacetylene torch is the tool to get your hands on. ■ ■

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Automatics—Those Still Cameras with “Brains”

[Continued from page 124]

(subminiatures) no larger than a pack of cigarettes, fully automatic cameras are made for five different film sizes: 16mm, 35mm, 127, 620, and 120.

What should you look for in an automatic? Here's a rundown on basics.

Meter-controlled settings. A number of automatics in the \$20-\$115 price bracket provide a variety of lens settings (f/stops), but limited shutter speeds, factory preset between 1/75 and 1/25 second for normal light, and from 1/30 to 1/50 second for dim light or flash. The electric eye controls only the size of the lens opening.

Starting around \$45 and ranging to \$375 or more are the automatics that provide a variety of shutter speeds. With these cameras, you usually preset the shutter speed you want; the electric-eye then matches it with the correct lens setting. On at least one, the shutter speed adjusts automatically rather than the lens opening.

On the newer programed controls, a camera may start out with the highest shutter speed and run through the sequence of lens openings, then drop down to the next shutter speed and try again, and so on until a correct exposure combination is obtained.

Many of the better meter-shutter combinations have built-in temperature compensating circuits, too.

Usually you can override the camera's automatic settings if you want to take pictures by flash or obtain special effects. The manual control lets you make your own lens settings on a camera having a fixed shutter speed. On cameras that offer a choice of shutter speeds, you can select any shutter speed and lens-opening combination you want, including Time and Bulb on some.

Under average conditions, you can rely on any good meter-shutter system to produce correctly exposed pictures. Every meter, however, bases its lens settings on the average brightness of a scene. What happens, then, if you want to photograph a person in light clothing standing against a dark background? At a fair distance, the background will dominate the meter reading, and your subject will be overexposed.

Some automatic cameras let you step up, aim the meter towards the subject at close range, take a close-up meter reading, and press the shutter release part way down to freeze the lens setting. Then you

back off and shoot the picture. You can also control the exposure by simply resetting the film rating on the camera dial as if you were using a faster film.

Fast focusing and viewfinder controls. These are musts with automatics. Reason: If it takes more than a split second to bring a subject into sharp focus, many of the benefits of instantaneous settings are nullified. Some of the lower-priced automatics have factory preset lenses that require no focusing. In the medium-price range, many automatics offer “zone focusing” as well as conventional foot-scale focusing.

Zone focusing is extremely fast. You simply turn the lens mount until a marker engraved below a word or symbol that describes your subject (Close-up, Group, Scene) is aligned with the regular foot-scale focusing mark. The speed and accuracy of this system is such that it is now being incorporated in some of the more expensive models to supplement their precise but slower rangefinder focusing systems.

Most automatics intended for eye-level use have from one to three bright-frame lines or parallax marks in their viewfinders. These are important composing aids for shooting at close range; they keep you from chopping off your subject's head. Look for them when you sight through a viewfinder—they're missing in some automatics.

Flash synchronization. Flash synchronization is built into virtually all automatics, but in most cases you'll have to switch to the manual setting in order to obtain the shutter speed of 1/30 to 1/50 second needed for flash. Thereafter lens settings are computed in the conventional (nonautomatic) way.

A few cameras provide “automatic” exposure control for flash pictures of subjects 5 to 25 feet away. This system does away with the arithmetic of computing f/stops and setting the lens openings manually. You key the guide number for the type of bulb you are using into one dial of the camera. The camera then makes its own lens setting for a correct average flash exposure as you focus upon a subject 5 to 25 feet away. For unusual flash situations, or for subjects nearer than 5 feet or farther than 25 feet, the camera is used as a nonautomatic.

Automatic signals. Those signs that appear and vanish like magic in the viewfinder are common to all eye-level auto-

Automatics—Still Cameras with "Brains"

matics. Some remind you when you are shooting on "Auto" or "Man," or when you have forgotten to wind to the next frame. Or a needle, visible in the viewfinder, may tell you the size of the lens opening that the electric eye is setting.

Warning signals, when the light is too dim for an electric-eye setting at a given shutter speed, range from red needles and red dots in some cameras to at least one (in the Retina Automatic III) that flashes the word "Stop." It locks the shutter so you can't shoot until you've corrected the situation.

Special features. These are the speed-and-convenience refinements you should look for. You should be able to operate all the essential controls with the thumb and no more than two fingers of your right hand. (With a twin-lens automatic, you'll probably need your left hand, too.)

Loading a camera should be fast and easy. There should be an automatic stop when the first frame is in shooting position. In the better 35mm automatics, a single-stroke thumb lever should advance the film, cock the shutter, and actuate the exposure counter. After each exposure, the shutter should lock until the next frame of film has been advanced—eliminating the danger of accidental double exposure.

While you're checking, note the little things, too. Does the camera have a cable-release socket, a standard-threaded tripod socket, a built-in self-timer, or provision for Time or Bulb exposures? Will it accept supplementary lenses? Does it have an accessory shoe that will accept your present flash equipment? Find out before you buy.

How rugged are the automatics? If Junior dunks it in the surf or boots it in the sand, you're likely to wind up with a headache in your wallet. Digging into an automatic's innards is a job for a professional repairman. And since it will take him just about twice as long to restore and replace parts in an automatic than in a conventional camera, he'll charge you accordingly.

How can you tell whether or not a meter-shutter combination is both rugged and accurate? One idea: Look for the name of the shutter manufacturer on the lens mount, or search the literature describing the camera. If you see such famous names as Kodak, Compur, or Alfred Gauthier, or Seikosha, Copal, or Citizen, you can probably breathe easy about the shutter. It's a

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good gamble that no camera manufacturer would link a fine shutter to a cheaply built meter.

There's no question that the automatic is replacing the box camera as the family camera. As for ruggedness and reliability, it was a medium-priced, fully automatic 35mm camera that withstood all the vibrations a booster rocket had to offer, and then brought back the first man-made color slides of outer space. On his flight in Friendship 7, Lt. Col. John Glenn used an Ansco Autoset 35mm camera (which sells for less than \$90) that had been modified for left-handed operation with a padded glove.

In addition to being the first man to take 35mm pictures in outer space, Col. Glenn achieved another first. He was the first man ever to lay a camera aside by simply "suspending" it in space until he needed it again.

What You Get for Your Money

This listing, far from complete, is intended only to show representative automatic cameras.

127 Cameras

These cameras take 12 pictures on a roll. Negative size is 1½" by 1½". Color transparencies are mounted as superslides in standard 2"-by-2" mounts.

Brownie Starmatic (about \$30). ASA 32 to 125. Optional manual control. Fixed focus.

Revere EE 127 Eyematic (about \$140). ASA 10 to 100. Optional manual control. Zone focusing.

USC Automatic 127 (about \$30). ASA 10 to 125. Built-in flash gun.

620 and 120 Cameras

These cameras give 12 exposures on a roll. Negative size is 2¼" by 2¼". Color transparencies can be trimmed to fit 2"-by-2" superslides.

Fujica Magic Eye 120 (\$19.95). Fixed-focus eye-level camera. Fixed shutter speed. Lens settings from f/11 to f/22.

USC Automatic Reflex (about \$30). Fixed-focus, twin-lens reflex. ASA 10 to 125. Shutter speed: 1/75.

Rollei Magic II (\$185). Twin-lens reflex. ASA 1 to 1,600. Prontomatic-S shutter with speeds from 1/30 to 1/500.

35mm Non-Rangefinder Cameras

Agfa Optima 1 (about \$70). ASA 10 to 100. Prontor-Lux shutter, 1/30 to 1/500.

Beau Rocca (\$60 to \$100 with different shutters). ASA 10 to 300. Speeds from 1 to 1/300.

Dacromatic 4D (about \$70). ASA 10 to 200. Prontor-Lux shutter, 1/30 to 1/500. Four push-buttons for zone focusing.

Fujica Automagic 35 (\$39.95). ASA 10 to 200. Scale focusing. Fujinar shutter, 1/40 to 1/250. Optional manual control.

Kalimat 35 (about \$60). ASA 1 to 640. Fixed shutter speed. Optional manual control.

Kodak Automatic 35B (about \$90). ASA 10 to 320. Kodak Synchro-80 shutter speed of 1/80. For flash, 1/40. Optional manual control.

Kodak Motormatic 35F (about \$100). ASA 10 to 640. Kodak automatic flash shutter, from 1/40 to 1/250. Optional manual control. Spring wind advances 10 frames of film individually or in sequence bursts.

Regula Olympia III (about \$90). ASA 10 to 800. Prontomatic shutter, 1/30 to 1/500. Scale focusing.

Ricoh Auto 35 (about \$50). ASA 10 to 200. Fixed-focus. Riken shutter, 1/25 and 1/60. Optional manual control.

Unimatic 606 (about \$110). ASA 10 to 800. Prontomatic shutter, 1/30 to 1/300. Optional manual control. Zone focusing.

Voigtlander Vito Automatic II (\$99.95). ASA 10 to 200. Prontomatic V shutter, 1/30 to 1/500. Optional manual control.

Zeiss Ikon Tenax (about \$109). ASA 10 to 1,300. Prontomatic S shutter, 1 to 1/500. Optional manual control.

35mm Rangefinder Cameras

Agfa Optima IIS (about \$100). ASA 10 to 250. Prontomatic shutter, 1/30 to 1/250.

Agfa Selecta-M (\$199). ASA 10 to 1,250. Speeds, 1/30 to 1/500. Motor-driven film transport. Optional manual control.

Ansco Autoset (about \$90). ASA 6 to 1,600. Speeds, 1/30 to 1/800. Optional manual control. Automatic flash computer.

Argus Autronic I (about \$80). ASA 10 to 400. Compur shutter, 1/30 to 1/500. Optional manual control.

Balda Super Baldamatic (about \$109). ASA 10 to 1,250. Compur automatic shutter, 1/30 to 1/500. Optional manual control. Accepts electric motor drive for remote sequence photography.

Beau Lightomatic II (about \$100). ASA 10 to 800. Copal shutter, 1 to 1/500. Optional manual control.

Canonet 1.9 (\$112.95). ASA 10 to 200. Copal shutter, 1 to 1/500. Optional manual control.

Fujica Auto M 35 (\$89.95). Fujinon f/2.8 lens. Shutter, 1/30 to 1/500, shifts speeds automatically. Optional manual control.

Fujica 35EE (\$119.95). ASA 10 to 200. Fujinon f/1.9 lens. Shutter, 1 to 1/1,000. Optional manual control.

Kodak Retina Automatic III (about \$130). ASA 10 to 1,300. Compur shutter, 1/30 to 1/500. Optional manual control.

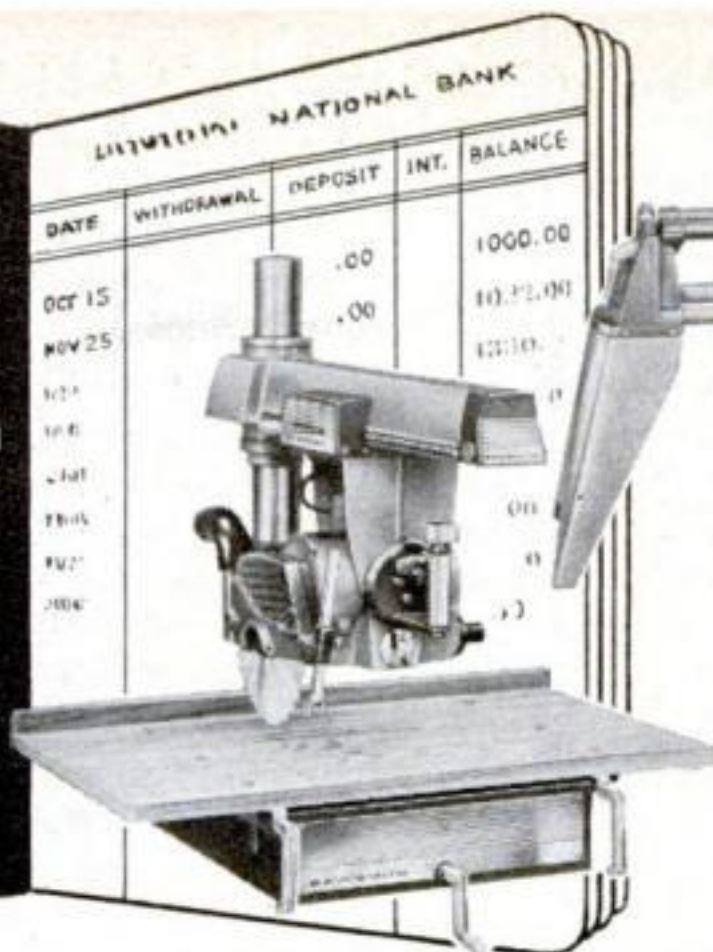
Olympus Auto Eye (\$79.95). ASA 10 to 800. Copal SV shutter, 1 to 1/500. Optional manual control.

Unimatic 707 (about \$130). ASA 10 to 800. Prontomatic shutter, 1/30 to 1/500. Optional manual control. Automatic filter compensation.

Yashica 35 EE (about \$100). ASA 10 to 800. Copal SVA shutter, 1 to 1/500. Optional manual control.

Zeiss Ikon Contessa-Matic I (about \$125). ASA 10 to 1,300. Prontor-SLK shutter, 1 to 1/500. Matched needle exposure system. Optional manual control. ■ ■

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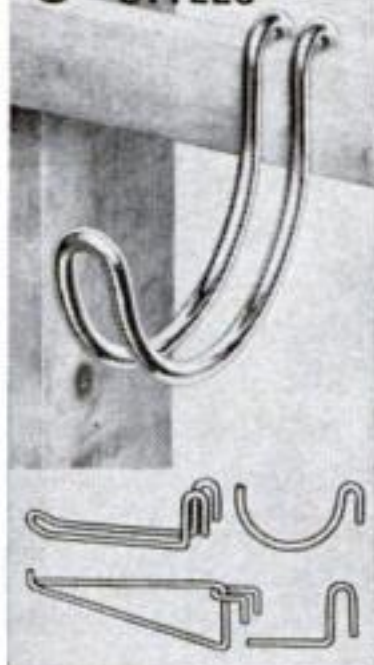
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Item: Watch that ramp angle—anything but the gentlest slopes will clobber your tailpipe because of the huge rear overhang.

Item: When you've parked for the night, there's nothing to do but eat and go to bed or watch TV. Not even an outdoor movie would accept this mastodon.

On the flat or uphill I had to drive by truck technique. The acceleration was slow, and I had to allow a lot of time and space for passing. It was the same for braking—I had to anticipate stops.

Mountains posed no problem. To keep the automatic drive from shifting up and down on long pulls, we simply locked out high gear on the pushbutton control panel. On no more than a half-dozen occasions—one, ascending the steep road to the Mesa Verde cliff dwellings—did we have to lock out second and resort to low. Low and second gear gave us plenty of compression braking on the downgrades.

An overall steering ratio of 24:1 did require some fast, deft work on sharp turns.

On two-lane roads I learned to watch my rear-view mirror for testy motorists trapped behind me on hills, and pull off at the first chance to let them by.

At night, we learned to keep our distance from other campers even where there were trailer hookups—to run the air conditioner we needed 220 volts, and our generator was noisy.

At Natchez, Miss., the generator began quitting. Homer took the door off the compartment that housed it—curing the trouble. "Vapor lock," he explained.

At Vicksburg we turned west. My wife, who had assiduously avoided the steering wheel up to now, asked to drive. Within an hour, completely at home, she was clocking 70.

"I forget to watch the speedometer," she explained.

To New Mexico's Carlsbad Caverns we went to see the bats fly at dusk, to Albuquerque to eat tacos and enchiladas in Old Town, to Santa Fe and Taos, to Mesa

Verde, to the southeastern tip of Utah to tour the grandeur of Monument Valley, to Boulder Dam.

"What do you think of the Motor Home?" I asked Homer as Rosemary, now a seasoned pilot, coolly wheeled our vehicle down the hairpin turns to the dam.

"Fine for two people," he replied.

That the air conditioner had quit again seemed unimportant now. The house car had served us well. It had fed us and slept us and banished the chill from our bones. It had provided us current to watch "Gun Smoke." But, like Homer, for me four was a crowd—at least on a long trip.

When we came to journey's end in Santa Monica, Calif., we were 23½ days out of White Plains. We had stopped for repairs, done the tourist spots, dawdled.

Our overnight camping sites had, necessarily, included some trailer camps. Parks aren't that plentiful. The count: ten state parks, three private parks, one roadside rest area (where passing trucks kept us awake), one all-night truck stop (ditto), five trailer camps, and three national parks.

Other vital statistics. We had spent \$30.50 on overnight parking. For the six nights my wife and I were on the road in the Motor Home, and the 17 nights the four of us slept aboard, motel bills would have been \$400 at a nominal \$10 double.

We had spent \$191.93 on food, including that in restaurants, and \$6.37 on propane gas, a total of \$198.30. Out of a total of 248 individual meals, we ate 40 out. Food would have cost us \$412 if we had eaten all our meals in restaurants and limited ourselves to \$5 a day per person.

Even in the heaviest of the standard sedans, we would have averaged twice the gas mileage. So \$98.21 must be debited to the Motor Home. So, for that matter, must \$1 spent washing bedding in laundromats.

On balance, the Motor Home apparently saved us \$283.99. But this, bear in mind, is disregarding the probability that a conventional car would have borne us more swiftly, in shorter time, and thus have cut the food and housing bills.

On the second morning after our arrival in California I slid behind the wheel of the Motor Home.

"I've got to deliver this to the Dodge people," I said.

"So soon?" asked my wife sadly. ■ ■

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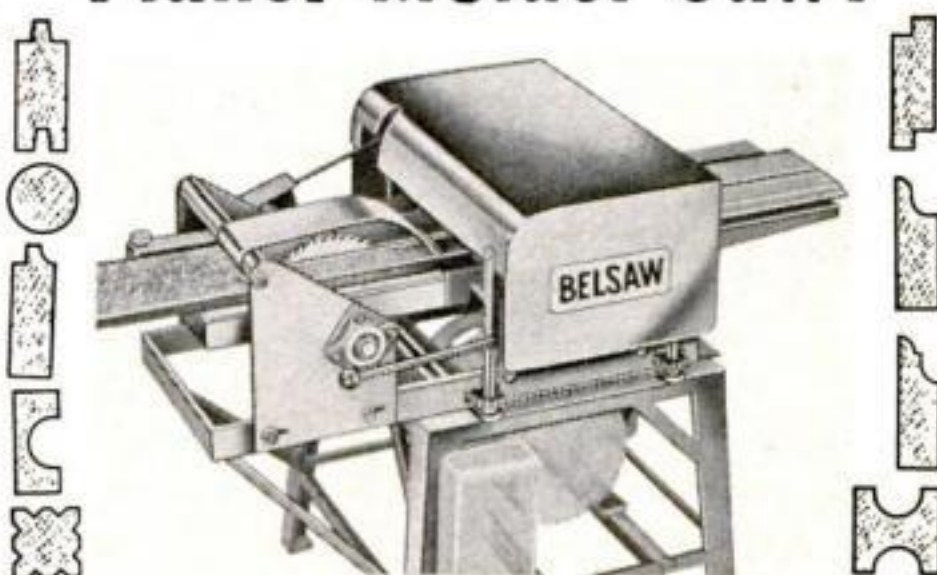


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Tracking. In Washington, when police were called to investigate a store robbery, they let the dog follow the most recent scent, were led to a nearby house. When they broke in, there stood a man holding a cash register.

In another instance, a 90-year-old man wandered from his home into a nearby swampy forest. A police dog was called, found the man alive and well in 20 minutes.

And early this year in Baltimore, an ex-con threw a baling hook, got a cop in the chest. "Get 'em," said the officer to his dog. The man jumped through a door, slammed it in the dog's face, then ran through a crowded dance hall and out the back door. The dog scented the runner's route through a hundred dancers. When the police finally caught up, the shepherd was standing over the prone man, gripping his posterior in viselike jaws. The hook-thrower stood up during his trial.

Crime prevention. While it's easy to point out specific instances where dogs have aided in arrests (last year, for instance, Baltimore's dogs assisted in 639 cases), by far the main value of dogs is their deterrent effect; they stop crimes before they happen. Says Baltimore trainer Kerbe: "The sight of an officer and a large shepherd dog strikes terror in the heart of would-be criminals. A lot of minds are changed."

Crooks *are* scared of the dogs. One trapped burglar jumped from a second-story window—breaking both ankles—when the cops shouted that they were sending the dogs after him.

Though the widespread use of police dogs is new in this country, the animals have been policing abroad since the seventeenth century. It wasn't until 1940, however, that London police got around to making police-dog training a science. And it was a 1956 article on London's dogs that piqued the interest of Baltimore's then-Commissioner James M. Hepbron.

"In normal circumstances," the assistant commissioner of London's Metropolitan Police was quoted as saying, "the criminal has all the advantages—darkness, initiative, and, often, numbers. The presence of one trained police dog can often make a single constable as effective as six."

Hepbron looked around the Baltimore force, found two men with dog-training experience: Sergeant Kerbe, who once han-

dled dogs for field trials, and Sgt. Irving Marders, former trainer of armed-forces canines. The men tried out two dogs, and the results were so impressive that six months later—in 1957—the K-9 Corps became a permanent part of the force. Today 60 dogs are employed.

In the last four years, scores of cities have sent men to study K-9 work under Marders' direction. They have returned to set up training schools of their own.

Watchdogs, too. Dogs are also being increasingly used for pure watch duty. Most famous are the six Dobermans used by Macy's in New York City. Eleven years ago the store was plagued by thieves. They'd hide in the store when it closed. After a leisurely night of thievery, they'd walk out in the morning with nicely wrapped parcels.

Then Macy's installed the dog squad. Every night watchdogs prowled from top floor to subbasement. After the first few arrests, word got out. It's been eight years now since Macy's has had an after-hours prowler.

Most cities buy dogs from professional breeders (good ones run to \$250), but Baltimore so far has succeeded in getting them free, donated by the public. The vast majority are turned down. The Corps insists on only purebred male shepherds (females have sex problems), usually about a year old (shepherds mature at two to three), physically fit, and neither vicious nor shy. (Last July a woman offered her dog to the Akron, Ohio, Canine Corps. "I'm sure he'll do a good job. He's already bitten three children." The dog was not accepted.)

The training. Finding the right men to work with the dogs is another problem. When Captain Gaeng gets an application from a patrolman, he first sees that the man lives in a house with a large yard. Then he talks with the man's wife and children to make sure they want to live with a dog—for the Jekyll-Hyde canines are house pets most of the time, manhunters only during working hours. Gaeng talks with neighbors, also—making sure they have no objection to living next door to a police dog.

Then school starts for both man and dog—14 weeks of intensive work where each policeman trains his own animal in obedience, searching, attacking, crowd control, trailing. Most important is obedience, for

Can Canine Cops Put Teeth in the Law?

dogs must be under complete voice control at all times. (But they'll work on their own, too. In London, a cop was knocked unconscious by a gang of thugs. When he came to, he found that his dog had rounded up the hoods and was holding them.)

If dogs are so good, why don't all large cities use them? Why don't such places as New York and Los Angeles slap the brakes on the soaring crime rate by enlisting dogs?

Objections. These boil down to three: fear that dogs will bite innocent people, with resulting lawsuits; trouble in getting policemen to team up with dogs; and cost.

Dogs *have* occasionally bitten the wrong person. One in Denver, in fact, became confused and bit his officer partner. But such accidents are rare. During the whole history of Baltimore's operation, only one claim has been paid by the city: A police dog was chained in his owner's back yard when a neighborhood kid poked him with a stick, then shot him with a popgun full of mud. Like any sensible dog, he bit.

The second objection—one of general police recruitment—is cited by Los Angeles Deputy Chief Roger Murdock. "The prospect of being 'married to a dog' would not be particularly attractive to a candidate who might be considering police work as a career," he says.

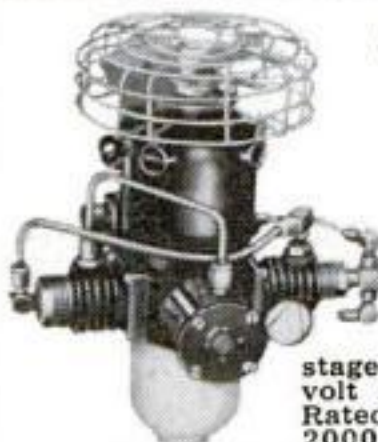
Retorts Baltimore's Captain Gaeng: "I just can't buy that. I can cite instances of candidates joining *because* they wanted to be in the K-9 Corps." So far, in fact, there's always been a waiting list of qualified volunteers.

Program pays off. The third factor—cost—is a legitimate one. Though Baltimore (and many other cities) get dogs free, food and vet fees run to about \$200 a year per dog, plus salaries of trainers, conversion of station wagons, rental of a training area. Police Chief Herbert Jenkins of Atlanta figures that his total yearly cost per dog—after the first year—is something like \$600.

On the other hand, there are savings—tough beats that ordinarily require two patrolmen can be covered by a single man and a dog.

More important, of course, is the saving of lives. "How much is it worth to find a lost child?" asks one K-9 member. Or as Chief William M. Lombard of Buffalo puts it: "If we can save one cop's life by using these dogs, we think we are repaid handsomely."

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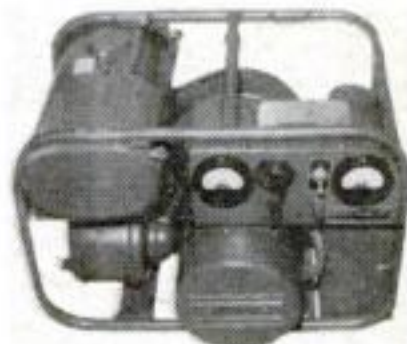
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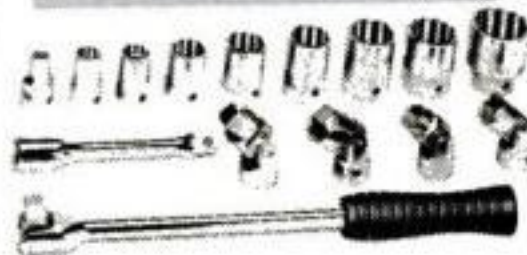
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been experimenting with aerosol sprays.

The approach is logical. You usually pick up respiratory infections through inhaling virus particles. They can stay airborne for hours.

Dr. Knight reasons further that the vast surface area of the lungs (80 square yards if the tissue were flattened out) is probably the most fertile spot in the body for respiratory infection. So a very little virus material—if it could reach the lungs—could go a long way in causing infection or triggering antibodies.

The trick is getting the aerosol particles down to a size where they won't be trapped by the mucous membranes that normally act as filters in the nose and throat.

Dr. Knight uses extremely delicate equipment built by Army engineers at Fort Detrick, Md. He can get particles down to less than .00004 inch across, and still measure how many of them will be mixed with air.

In one experiment, convict volunteers donned rubber masks and breathed air charged with one of the newer strains of virus for half a minute. Nearly all got colds.

The conclusion was obvious: If you can give people colds this way, you might immunize them the same way.

How does making cold vaccines painless and more efficient solve the multiple-ingredient problem?

It doesn't, but Dr. Werner Henle of the University of Pennsylvania has reported some very hopeful results. He found that after a succession of shots of a specific strain of live flu vaccine, lab animals showed an antibody rise to other strains of the same type, but ones to which they had never been exposed. Sort of "orphan" antibodies. This is unheard of—and as yet unexplained. But it does suggest that maybe a live cold vaccine doped the right way and given in successive shots over a period of months, might multiply its effects.

Will vaccines eventually solve all the virus problems—from colds to flu epidemics?

Probably not, for two reasons: One is that the viruses themselves keep changing. The other is that man keeps moving around and creating artificial conditions for a virus epidemic—like that recruit-camp infection. When the first adenoviruses were

isolated during epidemics in training camps, doctors wondered why the disease raged among raw recruits but not other personnel.

It seems now that this is related to a phenomenon known as "stranger's disease." People living in a relatively unchanging community become exposed and adapted to each other's viruses. After a time a kind of balanced state exists.

If you then introduce "strangers" into the group the balance is upset, and there may be a rash of new illnesses. (This is why servicemen spending long winters in Antarctica almost always come down with colds the first time the crews of the Navy ice-breakers appear in the spring.)

The situation is more complicated in the case of recruits' disease. Here young men coming from all over the country are kept in close quarters for several weeks. Not only does this create a brewer's paradise for virus mixing, but the batch is constantly being stirred by new arrivals. The result is that there is an ever-fresh supply of virus and susceptible persons.

What about "real" epidemics, like flu? Will we continue to have them?

Again, experts can't predict. Flu is one of the more notoriously unstable viruses. The world could be rid of it forever if, as one scientist put it, "the virus would only stand still."

But scientists now know a great deal about the influenza virus. And there are antibiotics that can cope with the bacterial infections that flu opens the door to. It was these that probably contributed the bulk of the 25 million deaths throughout the world in the famous flu epidemic of 1918-19.

Dr. Robert J. Huebner, Chief of the Infectious Disease Laboratory, at the National Institute of Allergy and Infectious Diseases, feels that Americans today are too conscious of flu. The "A" strains make news every two years because that's about the time it takes for immunity to wear off and a new crop of susceptible people to appear. But, even in peak years, flu accounts for only about 10 percent of all respiratory disease—the ones that are always with us.

What flu does point up is the possibility of a virus changing, not only from generation to generation within human hosts, but across species lines from animal to animal. Some virologists now think that the World

Are We Winning the 'Cold' War?

War I epidemic was caused by a variant of the virus that causes "swine" flu.

You mean a pig can catch flu?

Some form of it, yes, and other respiratory infections. And you might be able to catch the pig's flu—or "cold." The question is, how often does this actually happen in nature? Researchers know that you can make such things happen in the lab. Keep on inoculating a mouse or a rabbit with a human virus and the virus may eventually "take." It is this ability of a virus to adapt that has led to the development of cheap vaccines: A human virus has been made to grow in monkey-kidney cells or chick embryos, for example, and becomes weakened in the process.

But the virus doesn't always get weaker?

No. Sometimes a more virulent strain shows up or, as some of the newest experiments have shown, something quite different happens. Dr. Huebner injected hamsters with two strains of adenoviruses and they got cancer.

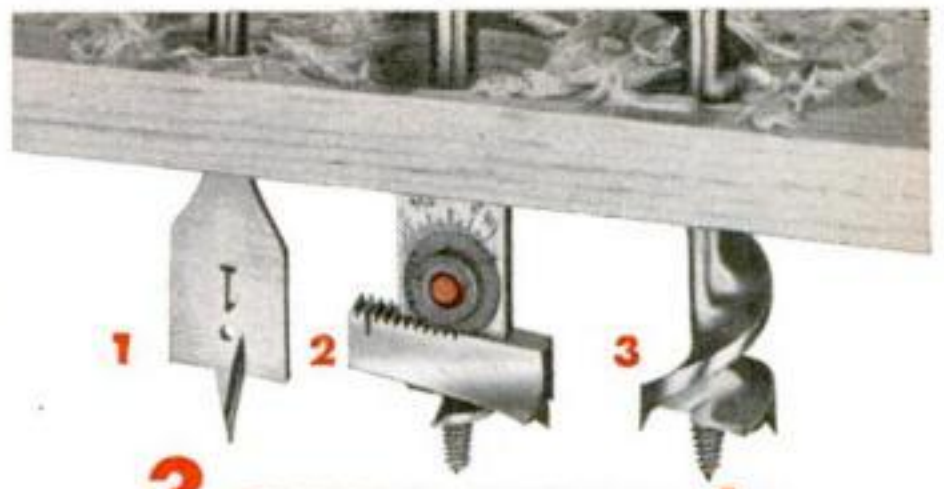
You mean a virus—a "cold" virus—may cause cancer?

Just possibly. Viruses have already been found in animal cancers. And some, like the polyoma virus of mice, can cause tumors to grow in other animals. Still a third suspicious clue is that a monkey-cancer virus, Simian Virus 40, can produce cancer-like changes in human cells grown in tissue culture.

Dr. Huebner feels these findings have a profound significance. The adenoviruses he and others have studied are similar to these animal viruses. They are also "latent" viruses, ones that persist in individuals long after recovery from infection. Sometimes viruses of this type have been found in persons who have shown no signs of infection—the "viruses in search of a disease" or "orphan" viruses.

No one yet has isolated a virus in a human cancer and, clearly, definitive tests on humans cannot be made.

But the growing awareness of the similarities between human and animal diseases, and the idea of latency, are suggestive. It won't surprise Dr. Huebner if the fight to win the "cold" war might not also lead to victory over cancer. Or vice versa. ■ ■



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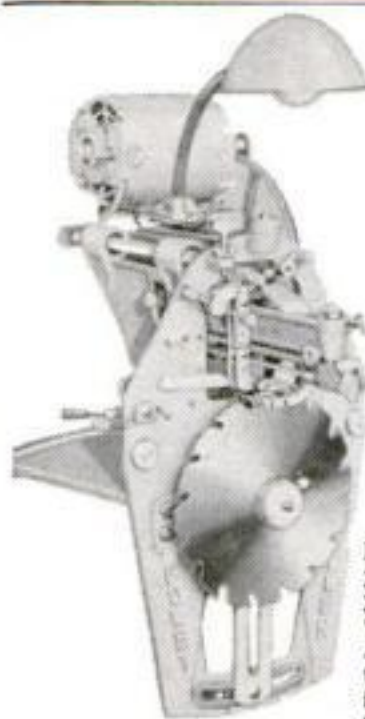
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are some 2,000 to 3,000 airfields already in existence overseas that can handle C-47 Gooney Birds (as against just a handful of 10,000-foot runways). So the TFXs can probably deploy into these available fields. Then, using their great range, they can fight while the engineers are building other fields closer to the battlefield.

It is possible, from bits and pieces of information, to construct a fairly good conception of the actual appearance of the switchblade airplane. If it is to land on aircraft carriers as well as sod fields, the pilot must have good visibility so he can see the deck clearly. This puts him right up on the snout. We know that a very high lift capability will be needed to work out of 3,000-foot runways with a military load. So we can expect the two engines to be embedded in the fuselage, side by side, and faired to provide aerodynamic lift from their shape. The flying switchblade probably will look very much like the Navy's A3J double-sonic shipboard bomber. Except, of course, that the wings will open and close like the blades of a switch-knife.

Why this variable sweep? For takeoffs, landings, and "loitering" near the target, the wings will be *fully spread*—since this provides maximum lift and minimum stalling speed, with fuel economy. Economy cruising speeds, on the other hand, demand a *semiswept* angle—maybe 40 degrees—which the pilot can produce by a touch of his switchblade button. The blinding-fast dash over the target can best be accomplished with the wings *fully swept*, turning the TFX into a streaking, supersonic projectile, capable of coming in low under radar.

Why didn't they do it long ago? They tried. In the early and middle 1950s, two experimental planes were tested at Edwards Flight Test Center in California—with dismal results. They had dangerous instability problems—centered on the hinge between the wing and the fuselage. This hinge had to allow the wings to open and shut like a pocketknife, increasing the sweep angle. But that wasn't all. The entire wing had to slide along the fuselage at the same time. If it didn't, the shift in the sweep angle threw the center of gravity of the airplane out of kilter, and the plane wanted to turn aerial flip-flops.

This is not a healthy flight maneuver, and the plane makers tried everything

they could think of to correct it. But no matter what they did, the hinge was heavy, complex, and undependable. If one wing slid back, for example, more than the other—or swept when the other didn't—the results were catastrophic. Industry gave up.

One man, however, refused to give up. He was John Stack, a scientist who worked for the National Advisory Committee for Aeronautics (now the National Aeronautics and Space Administration) at Langley Field, Va. Stack kept trying to devise a hinge that would beat the stability problem—and also provide a full sweep range. Finally, in August, 1959, Stack believed he had the answer. He called up the colonel who was in charge of new designs for the Tactical Air Command.

"This is John Stack at NACA," he said. "I think I may have whipped this variable-sweep deal. You want to take a look?"

The Stack Stub. The colonel most emphatically did. What Stack had done was simple. He had left a fairly long wing stub, with most of its lifting area ahead of the pivot point—so that when the switchblade wing opened or closed, it didn't make much change in the center of gravity. The result was to eliminate the complex mechanism for sliding the entire wing in synchronization with the sweep angle. The Stack Stub was the answer. All it needed was a pivot—not a serious problem.

Tactical Air looked, called in the industry. Industry looked, and the race was on. The reason is not hard to see. The TFX is only the beginning of the switchblade concept. Big transport planes could use variable-sweep wings to reduce the length of their takeoff and landing rolls, to improve fuel consumption when they are forced to loiter in a stackup, and to increase cruising speeds. The variable-sweep wing is undoubtedly going to be one of the hottest aviation developments in the 1960s. Many conservative aircraft companies predict that variable sweep will eventually be as common as flaps are today. ■ ■

Editor's note: As this issue was going to press, the Pentagon announced that a multibillion-dollar contract has been awarded to General Dynamics and Grumman for development of the TFX, now designated the F-111. Twenty-two test aircraft are involved, with the first to be delivered within 2½ years.

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ly washed the riflings out of any gun that fired it. After 20 shots, you went back for a new barrel.

Why fiddle around with .22s when higher calibers are so handy? Oddly enough, the practitioners of this curious art make both economic and ballistic sense. By beefing up a tiny pellet, you can attain tremendous speed and accuracy on much less powder than would be required to give larger, heavier bullets the same qualities.

While by no means cheap, the supercharged .22s are considerably less costly—and often more accurate—than their bigger brothers. They're a way of getting, in military jargon, "more bang for your buck."

But hot .22s do have their problems. Because they explode nearly anything they hit, they're less desirable for game shooting where you want your kill in as much of one piece as possible. Because of this, hot-.22 addicts actually argue that their play toys are less dangerous than conventional .22s because the slugs disintegrate on impact instead of continuing in flight or ricocheting all over the place. This is fine—if you don't miss. On an unbacked-up target, a stray shot can carry into the next county.

What guns can you use? None of the hopped-up .22s will fit into a standard .22 rifle—and with good reason. Since firing pressures build up to as much as 30 tons per square inch, they could blow an ordinary gun to bits.

Most hot shells require specially contoured chambers because of their size. But even the Winchester Magnum, similar in shape to a standard .22 Long Rifle, is carefully made a few thousandths oversize so it can't be slipped into a standard .22 rifle.

Most gunmakers, however, have been quick to come out with both rifles and pistols designed for the newer hot .22s. They're a little heavier but generally not much more expensive than standard models.

Some of the better-made standard .22 rifles can be converted to take the milder types of hot cartridges, such as Winchester's Magnum. The result is like asking your gas-station man to fill up the family car with pure ether.

Most guns used by avid sharpshooters, however, are not factory-made at all. They're laboriously handmade creations often worth the price of a new car. The more exotic don't even look like an ordinary

rifle. Their huge, solid-steel barrels, deliberately massive for stability, may resemble a truck axle with a tiny hole just big enough to emit a .22-size slug. The result is a cannon weighing up to 30 pounds.

It's easy to go off the deep end. A serious marksman will arrive at the range with enough paraphernalia to set up an artillery command post, including telescopic sights, a spotting scope, and a portable shell-reloading outfit.

Seldom fired freehand, the heavy guns are carefully bedded in a special rest and aligned with a level. Commercial ammunition is first shot off willy-nilly just to expand, or "fire-form," the brass shell casings to a precise fit in the gun's chamber. The clearance built into store-bought shells to make sure they'll fit all guns appalls the dedicated marksman.

The empty casings are then reloaded on the spot with bullets weighed and sorted to within 1/5,000 of an ounce so all shots fired in a group will be identical. The barrel is prewarmed with practice shots. Thereafter, all shots are made with the barrel at just that temperature—a few degrees off plays havoc with accuracy.

For added perfection, each shell is inserted in the chamber in exactly the same position as when originally fire-formed, by lining up a mark on its base. The more finicky purists will even find a particular casing that fires well, then use only it, stopping after each shot to reload it.

Varmint shooters are less fussy, but have their own special tricks. A farmer taking aim at a crow on the far side of a cornfield will tell you:

"I know he's 250 yards away because cornfields like this are always 250 yards wide. At this range, I know the bullet will drop about three inches. Everybody knows that a crow perches with his beak into the wind. By the way the leaves are blowing, I can tell that the bullet will be deflected about three inches to the side. So I just line up Mr. Crow's beak in my cross hairs and touch it off. Good-bye Mr. Crow."

All hot-.22 addicts have a common complaint: It takes so much fiddling to come up with exactly the right bullet weight, powder charge, and gun design that often a barrel's accuracy is gone by the time the perfect combination is found. Then you start all over again. ■ ■

Now . . . Snapshots in Sound

[Continued from page 121]

motor and batteries. In any case, if you use your tapes constantly, it is advisable to use a bulk eraser and demagnetizer that removes previous recordings when you merely place the tape reel on the erasing table. This restores the tape to its original quietness and eliminates reel sticking.

There is practically no wear on the tape in use; with reasonable care your recordings will last forever. Store them at room temperature (not near a heater or in the sun) and in reasonably dry surroundings.

Do not store tapes near strong magnetic fields such as from loud-speaker magnets, transformers, or electric motors.

About batteries. The service life you can expect from batteries depends largely on the conditions under which you use your tape recorder. Tape recorders are considered a heavy-drain usage on batteries.

If the recorder is operated continuously with some of the new long-playing tapes, two or three recordings and playbacks may exhaust the batteries. If operated intermittently, battery life is about doubled.

Batteries are rated under ideal conditions at a temperature of 70 degrees. But recorders are not likely to be operated under such conditions. Outdoors, changes in weather affect battery life. Cold requires more mechanical power and increases battery drain. On the other hand, leaving the recorder in a hot car with the windows closed is hard on both recorder and batteries. Temperatures above 90 result in very rapid battery deterioration.

Tests by makers indicate storage at 40 degrees will about double battery shelf life.

Some recorders are equipped with rechargeable, sealed, nickel-cadmium batteries. If yours is, check to see if ordinary dry cells can be substituted in an emergency. Rechargeable batteries sometimes fail at a critical point and they cannot be recharged rapidly; generally, 14 to 18 hours is needed.

Mercury batteries are more satisfactory for use at temperatures of 95 degrees and above. They are also more suitable for heavy drains over longer periods of time. Their heavy-drain life is rated in excess of 25 hours.

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Should You Tell on the Other Driver?

[Continued from page 81]

It's risky to set yourself up as a judge of speed.

The center-line crosser

This fellow runs you off the road. Should you complain? By all means, turn this fellow in quickly. Police say he's a real danger to everybody. If not caught, he'll do it again.

When you see an accident happen

Let's say you're looking when two cars collide at a traffic light. You see each driver accuse the other of running the red light. Both get arrested.

Yet you saw clearly that it was Driver A's fault and Driver B was innocent.

Should you say what you saw?

Police say a shameful number of motorists don't. "We ask people, 'Did you see what happened?'" says Sergeant Tappe. "But they keep mum. Yet we *know* some of them saw."

Some of these voiceless witnesses excuse their actions by saying they "don't want to get involved" or "don't want to have to go to court."

The driver who wouldn't be a witness

A Pennsylvania motorist once told Sergeant Tappe frankly: "If I ever see a collision I'm going to keep my mouth shut."

"But suppose you know a driver is falsely accused?" asked Tappe.

"That's his tough luck."

"Six months later," says Tappe, "I got a report of a head-on collision. When I got there one of the drivers involved was this same motorist, a friend of mine. Another driver was accusing him angrily of being on the wrong side of the road—a very serious charge.

"My friend knew other drivers had seen the accident, and he claimed he was innocent. He asked several to give him their names. No one would.

"He was in a real jam. After a long while an old man got up from a rocking chair on the porch of a house nearby. He came over and said, 'Well, I saw it, mister, and I know that the *other* driver was on the wrong side. Here's my name. I'll testify for you if necessary.'"

Later, the innocent driver saw Tappe. "I've changed my mind," he said. "I'll never again refuse to volunteer as a witness."

Should You Tell on the Other Driver?

The American Automobile Association says, however, that witnesses rarely get called to court. "Usually," says the AAA, "the mere knowledge that a reliable witness saw an accident results in settlement out of court and protects the innocent party."

If you see an accident happen, police say, you have a moral duty to offer your name, your card, or your license number to the drivers. If an officer appears, tell him, "I saw what happened, if you want anything from me." Be sure to tell him you're volunteering as a *disinterested* witness.

Lately, several well-meaning people have suggested that vigilantes be organized to spy on other drivers in their spare time. The Eastern newspaper printed a plan under which groups of drivers would be given blank postcards addressed to the police.

Any driver who sees another one do something that in his opinion was wrong would note the license number, time, place and offense. Then he'd send the card to the police.

The police in turn would mail a warning to the offender telling him he had been reported. The driver getting the warning would never know who saw him.

All this is guaranteed to give all drivers a sneaky feeling of being watched. But police in Connecticut, where the proposal was made, didn't want any part of it.

"We want help in keeping killers off the road," says Connecticut's Lieutenant Stecko. "But we certainly don't want a lot of vigilantes running around."

And so Connecticut's troopers politely but firmly turned the idea down. ■ ■

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Look: An Orbital Steam Engine

[Continued from page 142]

filing them roughly to shape can be made as shown. Harden the tool if possible.

Pistons. These are built up from a sleeve of tubing, a solid core partly drilled out, two small pieces of tubing and a ball. The cutter burr left on one piece of tubing retains the ball. Spot-solder this piece to the core before soldering the core into the sleeve. Push the con rod onto the stem within 1/16" of the ball and solder it.

Crankshaft cross. Insert 1/2" of the crankshaft tubing into a 5/32" hole drilled in hardwood or metal. Slip a 1/8" rod into the long end and carefully bend the tube about 20 degrees.

Solder the 1/8" legs into the crankshaft hub. Countersink the ends of these and the retainers with a 3/16" drill to form ball seats. File a 3/16"-wide notch in each sleeve. Solder the sleeves to the legs, insert the balls, and solder in the retainers, taking care to keep solder out of the sockets. Solder ball stems into the rods with 1/16" clearance.

Final assembly. Slide the valve sleeve onto its tube. Spot-solder the two retainers to center the steam tubes over the ports, but let the hub turn freely. Similarly mount the crankshaft cross on the crankshaft. Slide the pistons into their cylinders, pushing the crankshaft into the valve tube until the top piston just touches its steam tube and the bottom one is flush with or slightly out of its cylinder. If piston travel is too short or too long, carefully bend the crankshaft.

Valve timing. Adjust steam admission by rotating the crankshaft in the valve tube. Steam should begin to enter each cylinder with its piston at the top of its stroke. Spot-solder the crankshaft in position and turn the engine over by hand to check for free running. Oil all parts before testing on low air pressure, steam, or wiper vacuum from your car. If the engine starts readily and runs vigorously, solder the hub retainer and crankshaft permanently.

Power take-off. To take power off the engine, mount a separate shaft in its own bearing, with a U-shaped fork at one end engaging the steam tubes. The valve tube should support only the weight of the cylinder assembly. Don't fit a pulley or gear directly to it.

After it is run in, the engine should be self-starting; but turn it over by hand first to get rid of condensation. ■ ■

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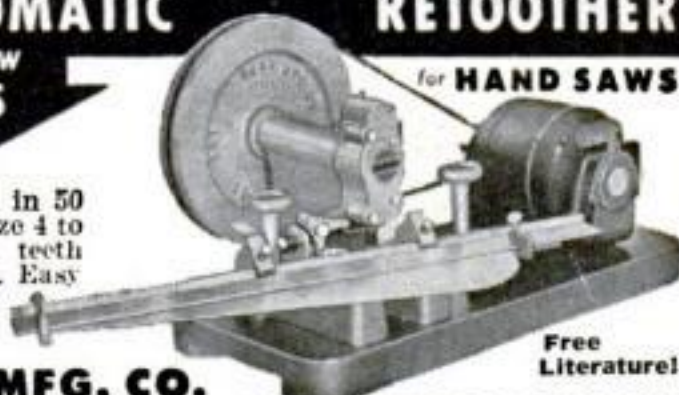
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What's Holding Up Disk Brakes?

[Continued from page 78]

How much disks would add to the cost of a new car is hard to pin down. Obviously, drums have a big cost advantage now because of large-scale production. In addition, the high pedal effort needed with disks makes unpowered brakes out of the question—so you have to tack the cost of a power booster onto the total cost of a brake system. Studebaker's optional disks (on front wheels only) add an extra \$97.95 to the price of the car. They break the price down into \$53 for the actual disks plus \$44.95 for the power booster.

Engineers differ about the precise nature of the advantages that are inherent in the disk design. For example: Recent research has not backed up the popular explanations for their excellent resistance to brake fade.

Which runs hotter? The accepted story has been that with five-sixths of the disk in direct contact with the air, the brake will run cooler than a drum, where the heat is trapped inside. But actual temperature measurements show that the disk runs hotter than an equivalent drum doing the same amount of work. Another advantage claimed: When a disk gets hot it expands *toward* the friction pads, giving added pedal reserve; drums expand *away* from the shoes, reducing the pedal reserve. This, of course, makes no practical difference in brake effectiveness unless you run out of reserve. On the best drum brakes now, the loss of pedal rarely exceeds a half-inch.

Reading between the lines of such reports, you get this message from Detroit brake engineers: "If you want to pay extra for premium brakes, we can still give you more for your money using drums." Like everything else on your car, brake systems are carefully tailored to do the job they're supposed to—but no more. Any extra pennies spent have to pay their way in added sales appeal.

In spite of the strong attachment to drums in Detroit, it appears that it is only a matter of time before they switch to disks. With the glamour that has rubbed off on disks from their use on foreign sports cars, they have a lot more sales appeal than any improved drum brake could achieve.

You'll see them first on premium-priced "personal" cars. The Avanti already has them. Thunderbird seems pretty sure to have them next year. Competitive cars can't afford to be far behind. ■ ■



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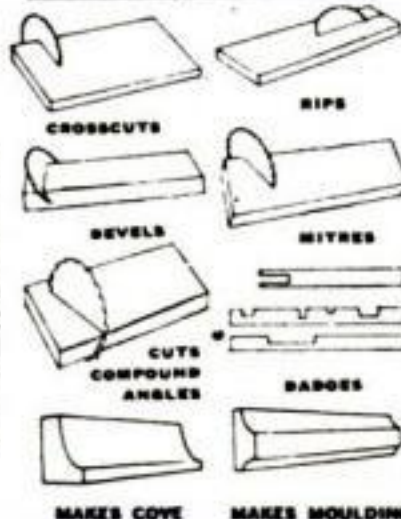


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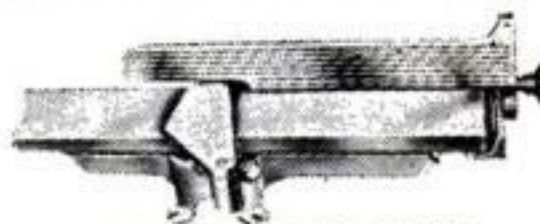
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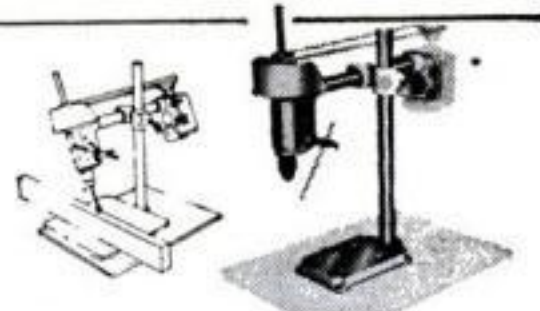
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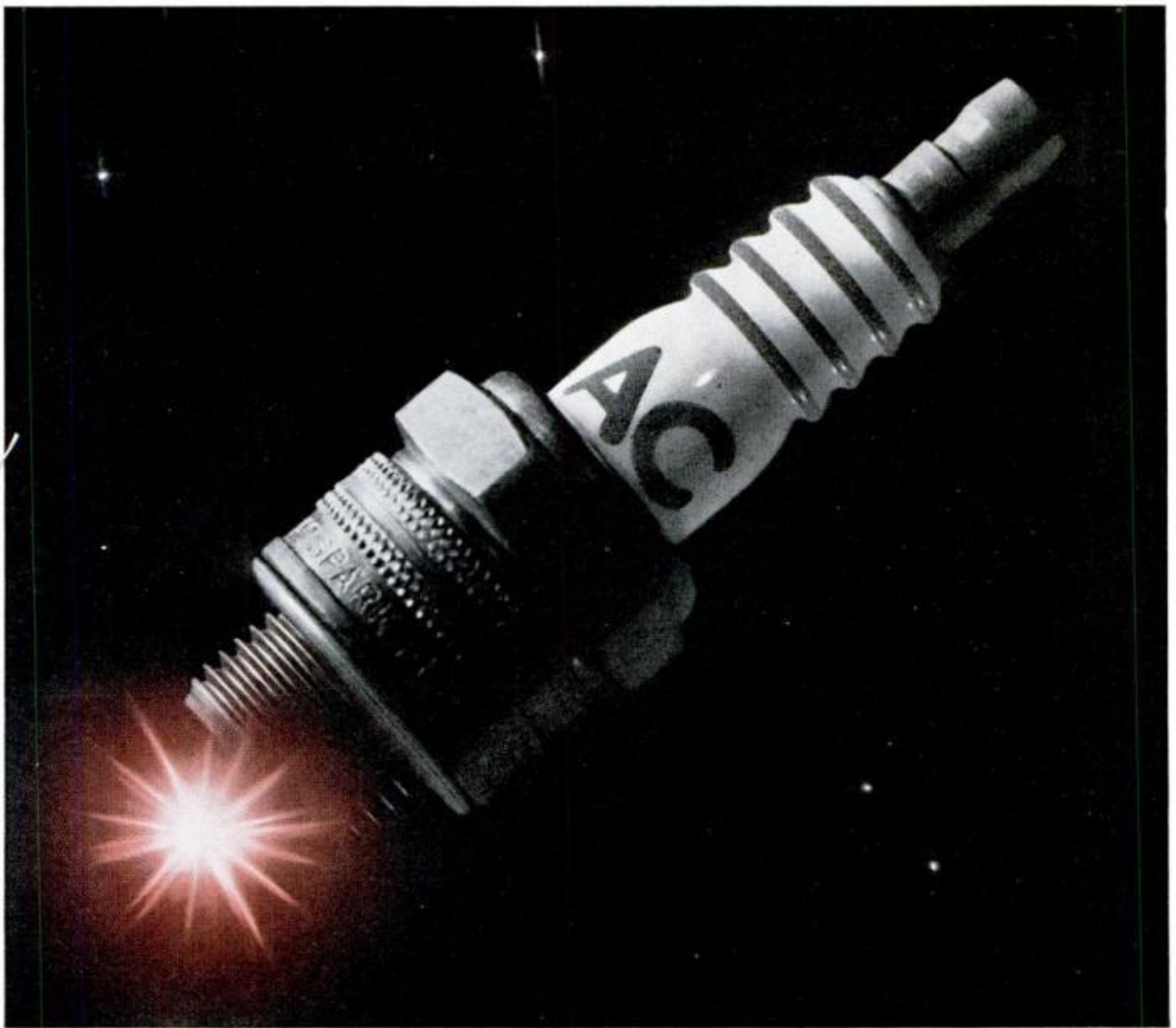
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
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